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Meik, Charles Scott

The improvement of  
London traffic

London

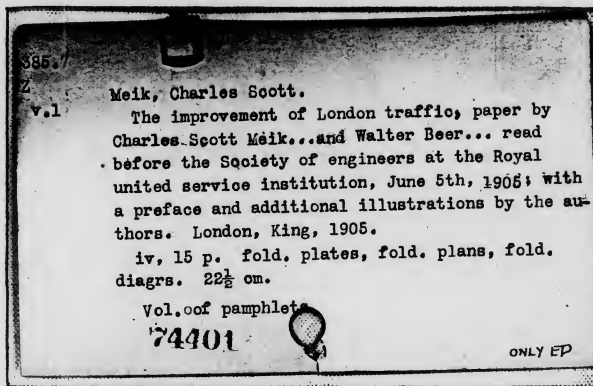
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# THE IMPROVEMENT OF LONDON TRAFFIC

PAPER BY

CHARLES SCOTT MEIK, M. INST. C.E.

AND

WALTER BEER, Assoc. M. INST. C.E.

READ BEFORE THE

SOCIETY OF ENGINEERS

AT

THE ROYAL UNITED SERVICE INSTITUTION.

JUNE 5TH, 1905.

WITH A

PREFACE AND ADDITIONAL ILLUSTRATIONS BY THE AUTHORS.

London :

P. S. KING & SON,  
ORCHARD HOUSE, WESTMINSTER.  
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## THE IMPROVEMENT OF LONDON TRAFFIC.

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THE inconvenience caused by the blocking of traffic in London streets and the need for improved passenger transport between its central and suburban districts are matters which closely touch both the convenience and personal comfort of each inhabitant living in or adjacent to the Metropolis. The study of existing conditions and of the means by which they may be improved must always be of interest, and especially so at the present time when the Royal Commission on London Traffic is about to publish the result of its two years' inquiry, and, it is to be hoped, to recommend measures calculated to permanently remove the present congestion.

Owing to the great complexity of the problem, the value and bearing of any proposals for its solution can hardly be appreciated without expert knowledge and special study. Moreover the issues involved are so important, and the consequences of a mistaken or half-hearted policy would be so far-reaching and irremediable, that the widest publicity should be given to any careful analysis of the present traffic conditions or to suggestions for their improvement.

In accordance with these views, and to meet numerous requests, we submit the results of two years' investigation in the form of the appended Paper, recently read before the Society of Engineers and reprinted by the kind permission of the Council of that Body, with the following explanatory remarks and additional illustrations used during, or suggested to us by, the discussion thereon.

In our opinion, which is confirmed by the evidence given before the Royal Commission on London Traffic, no sufficient or permanent improvement can, in face of the rapidly-growing population, be effected in the traffic conditions of London by further police control, local street widenings and like measures. New main thoroughfares, combined with railways and tramways, are an imperative necessity, and we

submit that these can be provided without entailing any excessive charge on the ratepayers, and will, if properly laid out, provide for all present requirements and for future needs for many years to come.

Such new main thoroughfares, or "Main Avenues" as we have designated them in our Paper, must fulfil certain conditions. (1) Each Avenue must extend through London from east to west or north to south, from open country to open country, be connected with the existing main roads into London and pass through the central business area, touching the chief centres of traffic, and must be capable of extension with the growth of population. (2) Where the traffic is already dense the Avenues must be at a high level, as in the case of Holborn Viaduct, in order to pass over and not obstruct cross traffic. (3) Separate accommodation, entirely independent of other traffic, should be provided for fast motor vehicles. (4) Each Avenue must have subways for the accommodation of pipes, cables, and access to drains, so as to obviate the nuisance of opening up the roadways by local authorities, gas, water and electric lighting companies. (5) For the greater part of its length each Avenue can and must be located so as not to interfere with existing main roads, and to pass through comparatively poor class property or partially-developed districts, and in such districts about three times the area of land actually required for the Avenue must be taken, and the surplus resold at its improved value to recoup the major part, if not all, of the first outlay.

During the discussion at the meeting of the Society of Engineers the main criticisms offered were, that proposals on such a large scale were unnecessary, since, in the opinion of the speakers, present traffic conditions could be sufficiently improved by better regulations and minor changes in the construction of the streets. Mr. Harper, Statistical Officer to the London County Council, said that he feared that in view of the magnitude of our proposals there would be great difficulty in financing them, and that this difficulty would render any estimates unreliable.

The text of our Paper shows that we have not neglected to consider the improvement which could undoubtedly be effected by less drastic measures, but, as already stated, we are convinced that action of this character can only be of local or temporary benefit. It is only necessary to consider the continuous growth of the population and ever-extending area of London to realise that the traffic conditions must become steadily worse, until twenty five years hence, with

a population within the area of Greater London of probably over nine millions, the state of affairs in Central London may well be intolerable.

The point raised by Mr. Harper is one which we had fully appreciated, and in reply we refer to the accompanying diagram (Fig. 1A) which shows that the recoupment of the cost of land and property may be expected to follow continuously on the expenditure, so that, while the total amounts may be enormous, the sum outstanding at any time would gradually increase at the rate of little more than £2,000,000 per annum to a total of £22,000,000 and then rapidly diminish. Similarly the expenditure on works would amount to only from £3,000,000 to £4,000,000 per annum for ten years, whereas during the last twenty years the average expenditure by railway and tramway companies upon the traffic facilities of London has averaged £5,000,000 per annum, and in addition there has been a very large outlay by municipal authorities on street improvements.

More serious would be the indirect outlay necessitated by rebuilding or development of the surplus lands, necessary to turn to account their improved value. This Mr. Harper put at £200,000,000. Now, as shown on the diagram already referred to, our estimates are based upon the assumption that the surplus land is sold gradually over a period of fifteen years, but, although sold, it is not to be expected that it would all be developed within that time. If we assume that complete development would follow within a total period of twenty years, we arrive a figure of £10,000,000 as the average annual expenditure under this head. This sum is a large one, but, in view of the magnitude of the building operations which are continually being carried on, it does not appear unreasonable to suppose that it could and would be provided. Some idea of the ordinary expenditure on building in London is given by the increase in the gross annual value of the Administrative County of London alone, which has an area of little more than one-sixth that of Greater London, for the year 1904-05 over that of 1903-04, amounting to £664,000, and twenty years' purchase thereof, or the approximate increment in capital value, to £13,280,000.

While dealing with the financial aspect of our proposals we should like to point out that most schemes for the improvement of cities involve a charge upon the rates, and we do not know of any other scheme suggested for London which it was contemplated would or could possibly be self-supporting. Our estimates show that our proposals would

not only be self-supporting, but might eventually yield a large profit, and, even if they were not realised in their entirety, there would be a large margin before actual loss would eventually result. Further, we submit that in view of the important improvements which, whether it be admitted that our arguments are altogether good or not, would indubitably result from our proposals, they ought not to be condemned, although it were shown that there would ultimately be a charge upon the rates, unless it were also proved that other, cheaper, and equally effective means are available.

To more fully illustrate our proposals we have added Figure 2A, a perspective drawing of a typical crossing of an existing street by a Main Avenue, the upper roads appear as a viaduct, under which the entrance to the lower roads can be seen; the drawing shows a suspended railway over the Main Avenue, but it will readily be understood that in the case of the adoption of subways or tubes this would be eliminated, and the alternative means of transport hidden beneath the surface of the existing street. Figure 3A shows a bridge to carry the proposed north and south Main Avenue over the Thames between Blackfriars and Waterloo Bridges, with a suspended railway upon it. Here the lower roads terminate at the Victoria Embankment and at the new embankment we propose on the south side of the river. If the railways were placed in shallow subway they could be carried either under the river or over the new bridge; in the case of tubes they would be carried under the river.

In conclusion, we desire to direct attention to the three alternative systems of railway construction which can equally well be combined with the Main Avenues we advocate. The overhead or suspended railway represents a great advance in æsthetic appearance and convenience upon the lines in use in Liverpool and in New York, but while its adoption would effect a very considerable economy in first cost, it is not an essential feature of our proposals, which could as easily be carried out with railways in shallow subways or in tubes.

C. S. MEIK.

WALTER BEER.

16, VICTORIA STREET,  
WESTMINSTER, S.W.

*June 20th, 1905.*



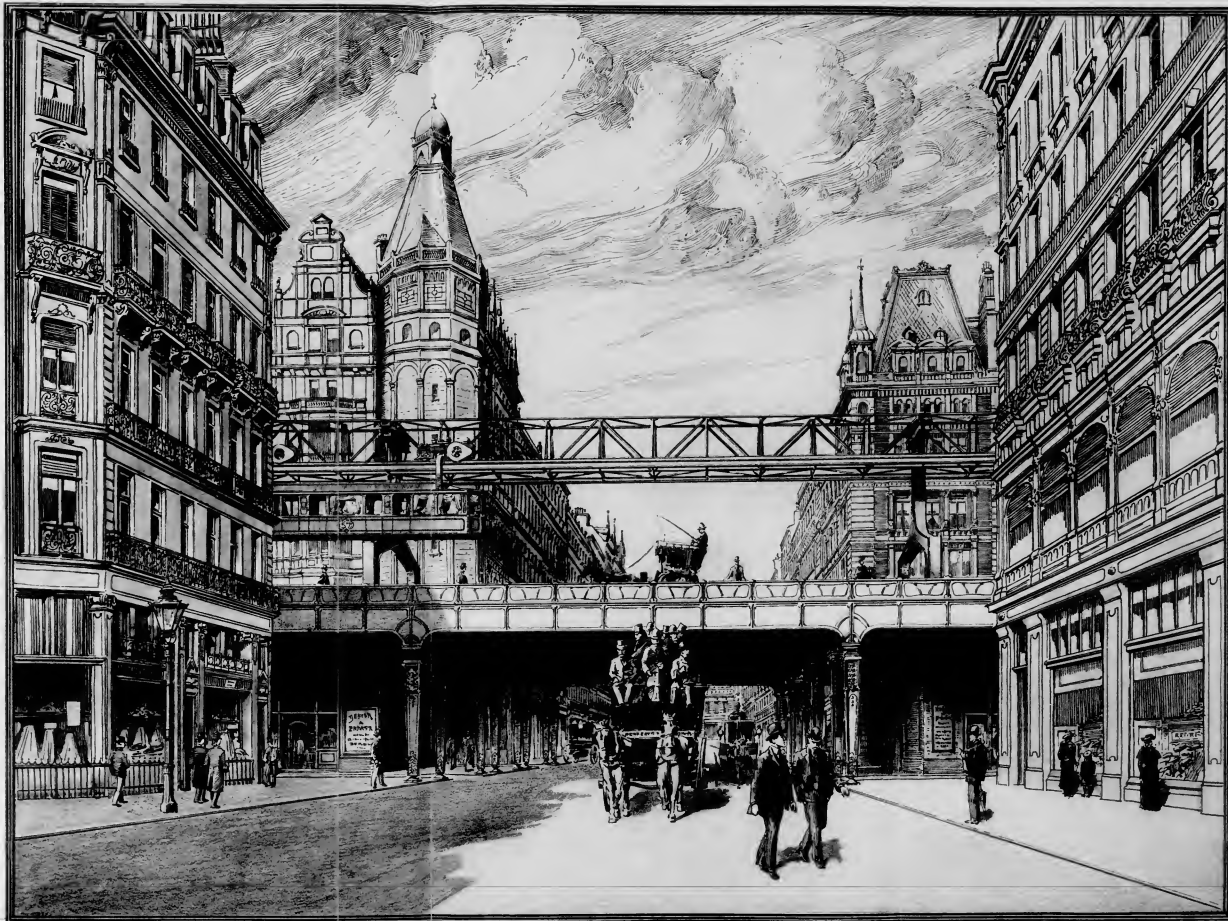
### PROPOSED MAIN AVENUES

[illegible]

Case III   "   "   "   Tubes

C S MEIK,  
16 Victoria Street SW  
WALTER BEER  
47 Victoria Street SW.

FIG. 2A.



Proposed Main Avenues. Typical Street Crossing.

C. S. MEIK,  
16, Victoria Street, S.W.  
WALTER BEER,  
47, Victoria Street, S.W.

INTENTIONAL SECOND EXPOSURE

FIG. 2A.



Proposed Main Avenues. Typical Street Crossing.

C. S. MEIK,  
16, Victoria Street, S.W.  
WALTER BEER,  
47, Victoria Street, S.W.

FIG. 3A.



Proposed Main Avenues.  
Bridge over River Thames carrying Suspended Railway.  
East Elevation.

C. S. MEIK,  
16, Victoria Street, S.W.  
WALTER BEER,  
47, Victoria Street, S.W.

INTENTIONAL SECOND EXPOSURE

FIG. 3A.



Proposed Main Avenues.  
Bridge over River Thames carrying Suspended Railway.  
East Elevation.

C. S. MEIK,  
16, Victoria Street, S.W.  
WALTER BEER,  
47, Victoria Street, S.W.

## SOCIETY OF ENGINEERS.

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*June 5th, 1905.*

NICHOLAS J. WEST, PRESIDENT, IN THE CHAIR.

### THE IMPROVEMENT OF LONDON TRAFFIC.

BY CHARLES SCOTT MEIK AND WALTER BEER.

It is more than two years since the Royal Commission on London Traffic began its labours, and a majority of the numerous governing bodies of the Metropolis have given their views as to the extent and causes of the congestion of vehicular traffic, the need for improved means of passenger transport, and the constitution of, and powers to be granted to, a new tribunal, which it is suggested shall be entrusted with the task of reorganising London. Having about June last year concluded the hearing of evidence and secured the more or less complete definition of the objects to be attained, the Commission proceeded with the difficult task of settling the remedial measures necessary. Many suggestions for the solution of parts of the complex problem were brought forward by numerous witnesses representing all classes of the community, and to weigh the value of this evidence, and, no doubt, to assist in formulating the ultimate recommendations, an advisory board was appointed, about twelve months ago, consisting of Sir John Wolfe Barry, K.C.B., who is also a member of the commission, Sir Benjamin Baker, K.C.B., K.C.M.G., and Mr. W. Barclay Parsons, consulting engineer to the Board of Rapid Transit Commissioners of New York. The high standing of these engineers warrants the expectation that the problem will be dealt with in no narrow-minded manner, but that the proposals which they will recommend will be on a broad comprehensive basis, meeting the needs of all districts, and sufficient to settle the future lines of dealing with the traffic of London for many years to come.

The mass of evidence collected clearly shows that the traffic conditions of London are not only at present unsatisfactory, but must inevitably become worse, if measures for their improvement are not promptly undertaken. As might be expected, the light thrown upon the hindrances to, or lack of means of,

locomotion serves to indicate how the former may be removed and the latter supplied. Much may be done by the improvement of existing facilities. In the case of vehicular traffic some good would undoubtedly be done by (1) an extension, or more vigorous enforcement, of the powers of police regulation, prohibiting standing vehicles and crawling cabs in busy streets during certain hours of the day, and compelling slow vehicles to travel close to the footway and to follow particular routes; (2) the construction of pipe subways, so that it should not be necessary to break up the surface of the streets for repairs to mains and cables and the like, and the better ordering of such work where the importance of a road does not justify expenditure on a subway. Much could also be effected by local widenings, new connecting streets, bridges carrying one stream of traffic over the other at important cross roads, as has been proposed at Wellington Street, Strand, and similar measures. As regards passenger traffic: the electrification of suburban railways and tramways, the construction of various authorised tube lines, and the completion of the extensive widenings, which several of the larger railway companies have been engaged upon for years, will very largely increase the capacity of the existing means of transport. Further improvement will result from the many miles of new tramway built or about to be built; from certain proposed tubes, as, for instance, the North-East London Railway, which is again before Parliament; and from the substitution of motor for horse omnibuses, which is gradually taking place. If these improvements were all carried out, and particularly, if quickly done, the benefit to London would, no doubt, be marked, but there is a general consensus of opinion that more extended measures are necessary. This is especially the case with regard to vehicular traffic; and in view of the continued growth of population and the increase in the travelling habit, which the expansion of London and improved and cheaper means of travel must bring about, it is certain that the provision of further means of passenger transport is no less important.

The weight of evidence given before the Royal Commission is in favour of the construction of new main thoroughfares, somewhat on the lines of Kingsway, the new street, now nearly completed, between Holborn and the Strand, but extending from congested neighbourhoods into the suburbs. Representatives of the London County Council illustrated their views by suggesting new roads from Muswell Hill via Kingsway to near the Crystal Palace; from the Tower Bridge northwards to Hackney Marsh and southwards through Greenwich; from Westminster to Barnes and from Portland Place to Paddington;

as examples of what they considered necessary. They favoured a road width of not less than 100 feet, but preferably of 160 feet, and roughly estimated the cost of the wider road at 2,000,000*l.* per mile. But they anticipated that, if considerably more land were acquired than was necessary for the actual construction of the roadway, it would be possible to recoup a large part of the cost of the whole by the sale of the surplus. There is little doubt that by the construction of new arterial thoroughfares the present congestion of vehicular traffic could be effectively relieved, and the future needs of London provided for. But before adopting this remedy it is advisable to enquire not only what the cost would be but whether it might not give rise to new difficulties.

It is obvious that, in order to be useful, new main thoroughfares must tap existing centres of traffic and also follow reasonably direct routes. In other words, they must traverse central London, and however carefully they might be laid out they would necessitate the acquisition of very valuable property. The cost of such thoroughfares would therefore be enormous, but not necessarily prohibitive, if it could be shown that by the purchase and resale of surplus land large recoupment is possible, and that the new routes could be turned to profitable account by the construction of railways and tramways along them. Thus the question of cost may best be discussed with reference to concrete proposals and is left, for the moment, with the remark that a new thoroughfare, passing right through London, might be made to yield a large profit from the re-sale of land in poor districts, and in particular in insanitary areas, which would assist in defraying the cost of other sections and, further, such a thoroughfare would, almost of necessity, be a valuable railway and tramway route.

The dislocation of business and the destruction of working class dwellings, which must attend the construction of extensive new roads, are matters requiring serious consideration. Workmen disturbed can be re-housed, probably better and profitably by extending the new roads right out into distant suburbs, as yet sparsely built over, but the workmen must be provided with quick and cheap means of reaching the central area. Thus it is not only upon financial grounds that the construction of railways and tramways along the new thoroughfares is necessary.

To the land required for the actual construction of a roadway must be added that which must be bought to re-sell at the enhanced value which the improvement will give to it. Assuming the width of a new road to be 160 feet, and taking the same depth of surplus land on either side, the total to be acquired would be 480 feet. The purchase of such a strip of



land in London, and the destruction of the buildings upon it, would unquestionably result in considerable dislocation of business, though this need not be so great as would at first appear. The mere constructional works would, if only from their magnitude, take time to carry out and the existing buildings on the surplus land could be pulled down gradually, as arrangements were made for the erection of new structures in their place. These would be commensurate in size with the importance of the new thoroughfares, and might be reasonably expected to have a larger capacity than the whole of the old buildings, even including those which had stood upon sites occupied by the new road.

Where the purchase of surplus land would not be profitable or the financial result doubtful, it would naturally be avoided or restricted within narrow limits. This would occur in districts where important businesses are now carried on and interference with such quarters would, therefore, be minimised. In the city and at other points, where the property is of great value, it would clearly be the right policy to take as little as possible and even to reduce the width of the new road, if it could be done without prejudicially affecting its usefulness. This question of business dislocation is most important, but to discuss it in all its bearings is impossible. If all were said, it would probably amount to striking a balance between the value of a great permanent improvement in the traffic facilities of the whole of London and the temporary inconvenience of sections of the business population, and whether the credit or debit side of the account would be the larger must depend upon the details of any proposal.

Another very difficult point to be considered is whether new thoroughfares, if made, would attract traffic from established courses and, a similar point, whether it would be possible to sell a large area of surplus land for its full value within a reasonable time. It is difficult to give a general answer to these questions, but, if new roads are located so as to tap existing centres of traffic, it is hard to believe that, in spite of the conservatism of the British character, they would not be used in preference to overcrowded streets, and, if so used, the sale of the surplus land would be materially assisted. It appears, moreover, probable that the large extent of operations might even be beneficial, because no large proportion of the manufacturers, or others disturbed, would readily find equally convenient accommodation in other parts of London.

In view of the very large and increasing number of motor vehicles now employed, and the desirability of enabling such vehicles to make use of their available high speed, the great importance of combining a special motor road with any new

main thoroughfare can hardly be too strongly urged. Such a road would have great commercial value, and would also make for the greater safety of the public and the better regulation of motor traffic. It should be so constructed that motors travelling along it would be entirely separated from the ordinary traffic, and it should be carried over or under all cross roads. This last requirement is vital; without it there would be little advantage in having a special motor track in London, because the cross streets are so frequent that there would be continuous delay. Even in the case of a new road designed for general traffic, it would probably be best to carry it over or under existing roads rather than suffer the delays, which must otherwise ensue. The extent of these delays can be seen at any important street junction in London, where during crowded hours, it will be found that the traffic in any one direction is probably held up for as much as thirty in every sixty minutes.

As may be gathered from the few points already dealt with, no accurate opinion can really be formed as to the feasibility, and probable effect, of constructing new main roads, except upon the basis of some definite scheme and the authors therefore submit certain proposals which were recently laid by them before the Royal Commission on London Traffic, and which proposals are still under consideration by that body. This scheme is the joint work of the authors, and relates to the construction of two new main thoroughfares, or "Main Avenues," as they may for convenience be called, each 24 miles long, one traversing London from north to south and the other from west to east, and a number of subsidiary or branch roads, as shown in Fig. 1 of the illustrations. It is proposed to construct both railways and tramways along the Main Avenues, and tramways along the branch roads, so that these proposals also bear upon the transport of passengers, particularly in relation to the morning and evening traffic between central London and the suburbs.

The proposed north and south Main Avenue commences north of Enfield and passes to the westward of that place, through Tottenham, South Hornsey and Highbury to the Parcels Post Office at Mount Pleasant, between Pentonville Road and Rosebury Avenue, where it would have a junction with the proposed west and east Avenue. Thence it is continued through Hutton Garden, across Holborn and the Strand to St. George's Circus, passing immediately east of the Temple and over the Thames by means of a new bridge. From St. George's Circus, the Main Avenue is continued through Camberwell, Lambeth and West Dulwich, to a point south of the village of Beddington, passing east of the Crystal Palace and between Croydon and Wallington. By means of branch roads, it is proposed to connect this Main



Avenue with Finchley to the north-west, giving access to the Great North Road; with Walthamstow, to the north-east, connecting with the main road to Epping and Cambridge; with Putney and Wandsworth, to the west, linking it with the Portsmouth Road through Kingston with Eltham, to the east; with Addington and Purley, to the south-east, and Sutton, to the south-west, affording connections with the main Brighton roads through Epsom and Croydon. It is also proposed to construct a new cross road between the Tower and Vauxhall Bridges, which would join the Main Avenue, south of Newington Butts. A new embankment on the south side of the river is suggested, to directly connect this Avenue with Blackfriars Bridge to the east, and Waterloo Bridge to the west, as seen in Fig. 7.

The proposed west and east Main Avenue commences in the vicinity of Osterley Park, near Hounslow, and passes through Ealing, Acton, Notting Hill, Paddington, and Marylebone, to the junction with the north and south Main Avenue at Mount Pleasant. The Edgware Road is crossed at Praed Street, and the Avenue is carried south of the Marylebone Road and along the Euston Road, past St. Pancras to King's Cross, where it bends sharply to the south-east and, as already stated, has a junction with the north and south Main Avenue. From Mount Pleasant this Avenue continues eastwards to Liverpool Street. For this section alternative proposals are put forward. By one the Avenue would pass through Charterhouse and would keep north of the Metropolitan Railway. By the other it would trend southwards round Charterhouse, and would follow the Metropolitan Railway to Moorgate Street. At Liverpool Street a modification is made in the design of the Avenue, enabling the width to be reduced, and the quantity of land required to construct this important section—which is here located over the Metropolitan Railway—is minimised as far as possible. From Liverpool Street the Main Avenue continues almost due east, crossing the Whitechapel Road and passing through Stepney and Bow Common. Trending slightly northwards, it passes on through East Ham, and, leaving Barking to the north, terminates in the vicinity of Dagenham. Branch roads are proposed to connect the west and east Main Avenue with Kew to the south; Perivale and Sudbery to the north-west, and Ilford and Romford to the north-east, giving direct communication with the main roads on the west and east of London.

These Main Avenues would accommodate traffic passing through greater London, and assisted by the branch roads, would form the most convenient route to the city and neighbourhood for a large number of the country districts, lying immediately outside the county boundary. The north and south Avenue

would draw traffic from all the northern railway termini by means of the west and east Avenue, and from Victoria, London Bridge, and Bricklayers Arms goods stations by means of the new cross-road between the Tower and Vauxhall Bridges. Waterloo Station would also be reached by the proposed new embankment. The west and east Main Avenue would tap the railway termini at Paddington, Marylebone, Euston, St. Pancras, King's Cross, Broad Street and Liverpool Street. It would pass through some of the most congested parts of the city, and close to the East and West India Docks. Both Main Avenues have been laid out to pass, where possible, through poor class property. The north and south Avenue would traverse the insanitary areas near Saffron Hill and between the Thames and St. George's Circus, and the overcrowded districts in or near Clerkenwell and St. Pancras. The west and east Avenue would practically do away with the insanitary areas near Houndsditch and Petticoat Lane, and with sections of the overcrowded districts of Whitechapel and Stepney. The Avenues terminate in open country, which they are designed to develop; but the intermediate districts passed through are already largely populated, and need, or will shortly need, additional means of reaching the city and west end. The north and south Main Avenue passes close to the building sites, acquired by the London County Council, at Tottenham and Norbury, which are expected to accommodate respectively about 40,000 and 6000 people.

In laying down the route of these Avenues no endeavour was made to follow existing roads; but, on the contrary, important streets at any rate were avoided. This was done to minimise disturbance to business, and because it was found that it was far cheaper to take an entirely new route than to attempt to follow and widen existing roads. The width suggested for the Main Avenues is 160 feet, and for the branch roads 100 feet. The new street, between Holborn and the Strand, is only 100 feet wide; Holborn and Oxford Streets average 70 feet wide, the Clerkenwell and Edgware Roads 60 feet wide, and these are some of the broadest, and most important, main roads in London. The foregoing dimensions for the new Avenues and roads may, therefore, appear excessive, but most of the expert evidence tendered to the Royal Commission is in favour of the adoption of some such widths for new main roads, and it must be remembered that in the case of the Main Avenues, it is proposed to provide a special track for motor vehicles.

Reference has already been made to the necessity of carrying any new main thoroughfares over, or under, existing important streets. The Main Avenues described would cross many such streets and, in fact, within a radius of 4 miles from St. Paul's,

there would be 38 crossings on the north and south Avenue, and an even larger number on the west and east Avenue. It is not difficult to understand that much, if not all, of the usefulness of the new Avenues would be lost, if traffic along them were delayed at these crossings, not to speak of the effect of minor side roads. Moreover, the traffic on the new Avenues would equally interfere with that on the cross streets, and would, therefore aggravate any existing congestion there. This danger could be avoided by carrying the Avenues, by means of bridges, over cross streets, keeping the new roads on the ground level between the points of crossing, but such bridges would have to be so numerous that the roads would become a series of inclines, and their construction impracticable. The alternative is, obviously, to build at a high level, so that the new Avenues would pass over all cross streets without difficulty. Holborn Viaduct where it crosses Farringdon Street, illustrates on a small scale the general method of construction as regards the upper street. In the outer districts of London, where the cross roads are neither so numerous, nor the traffic upon them so dense, such a construction would not be required. In this case the north and south Main Avenue is brought down to the ground level immediately to the north of Tottenham and to the south of the Crystal Palace. The west and east Avenue is similarly treated west of Acton and east of West Ham (see Figs. 1 and 4). In fixing these points, which are further out than is required by the present traffic conditions, regard is had to the future growth of London. If it is necessary, for the convenience of ordinary traffic, to take new thoroughfares over or under cross streets, it must be still more important to do this in the case of a special road for motor vehicles only.

Where it is proposed to construct the Main Avenues as elevated roads, they would have the following cross section (see Figs. 2 and 3). The Main Avenue proper, or upper deck, would be 23 feet above the ground level and built in halves, each of which would have a footpath, next the building line, 12 feet in width, a 40 feet roadway, and a second footpath 14 feet wide. Between the halves, and bordered by the central footpaths, would be the motor road, with an effective width of 26 feet. This road would be normally placed at ground level (see Fig. 2), but at important cross roads it would rise by inclines to the level of the upper deck and pass over them (see Fig. 3). With the motor road at ground level, free communication, by means of bridges, of any desired width, would be possible between the halves of the upper deck. The space below the upper deck would be utilised for lower roads, situated one under each half of the upper deck, intended for the use of slow traffic and to

facilitate the access of goods to the lower floors of shops and warehouses. At the side of each of the lower roads, and underneath a footpath there provided, would be pipe subways, this being the most convenient position for house connections. On the elevated or double-decked section of a Main Avenue the buildings would all be built up from the edge of the footpaths without forecourts or gardens, and the level of the upper deck would be regarded as their ground level and the storey fronting on the lower roads as a basement. With the motor road down at the level of the lower roads, in its normal position, light and air would be admitted to the latter. To enable it to be kept at this level for the greatest possible proportion of its length, the gradients might be 1 in 20, which would not be permissible, if it were to be used by other than motor vehicles.

From what has been stated it will be seen that the frequency of cross roads, and the necessity of carrying the Main Avenues over or under them, is the governing factor in the design of cross section just described, but, at the same time, a number of incidental advantages are secured. For instance, it would not be necessary to carry unimportant cross streets through, but simply to connect them with one side of the lower road, and allow the traffic to proceed to the right or left, until a more important street was reached. This is a matter of some importance, as it reduces the number of inclines required on the motor road, and enables frequent cross bridges to be built between the halves of the upper deck. The accommodation given by the lower roads would also be useful, as it would enable the Main Avenue proper, or upper deck, to be kept free from slow vehicular traffic and would provide space for loading and unloading heavy goods, so that standing carts on the upper deck, with the nuisance which they usually cause in a busy thoroughfare, could be entirely avoided. It is also proposed, and would be quite easy to arrange, to do all the scavenging from the lower roads, everything being washed down suitable drains from the upper deck to collecting pits accessible from below. Access to the upper deck would be by means of inclines for vehicular traffic (see Fig. 6), and by inclines and steps for pedestrians. The inclines would occur at all important cross streets, and at these points it would be possible for motor cars either to leave or to enter the motor road. No gradient on the Main Avenues proposed—with the exception of the special motor road gradients—would exceed 1 in 35, and the gradients of the connecting or approach roads to the upper deck should be limited to 1 in 30.

As already stated the total length of the Main Avenues is 48 miles, of which it is proposed that 31 miles should be elevated

and constructed as described. On the remaining 17 miles the width of 160 feet would be continued, but the upper deck would be brought down to ground level, and the upper and lower roads merged into one (see Fig. 4). The motor road would remain in the centre, but would be crossed on the level by vehicles or pedestrians. In the case of a particularly important cross-road occurring, the Main Avenue, together with the motor road, would be carried over it by a bridge, but this would seldom be necessary. These portions of the Main Avenues are so designed that, at some future date, when the growth of the population might require it, they could easily be converted into the elevated or double decked structure, without either the acquisition of further land or serious interference with the traffic along them.

As has been pointed out, the Main Avenues would lose much of their usefulness if not combined with railways and tramways, and it will now be convenient to consider more in detail what it is necessary to provide. It was clearly proved in connection with the numerous tube railway schemes, which have come before parliament in recent years, that existing railways cannot adequately deal with even the present suburban traffic of certain neighbourhoods, much less with the probable future traffic. But, apart from the relief of these railways, it is necessary to open up new districts to meet the growing needs of London and, in particular, to enable, and encourage, the working classes to make their homes in the remoter suburbs instead of living in overcrowded tenements in densely populated areas. If the proposed Main Avenues and branch roads be constructed, a very large number of working class dwellings would be pulled down and, on financial grounds alone, it would be impossible to house the persons disturbed anywhere but on the outskirts of London.

How great the future needs of London are likely to become may be inferred from the figures put forward by Mr. Edgar Harper, the statistical officer to the London County Council, who estimated, in his evidence before the Royal Commission on London Traffic, that the population of greater London in 1931 will amount to 9,277,163, and that by far the major portion of the increase must take place in suburban districts. Thus, it appears certain that, even when the existing railway companies have completed the widening works which many of them have in hand, and the numerous tube railways are constructed and working, there will still remain an enormous field to be covered. The Main Avenues suggested follow routes in every way suitable for passenger traffic, and railways constructed along them, in combination with a system of feeder tramways, would be capable of serving an immense existing and future population.

The chief object to be secured is the rapid conveyance of passengers between their homes and places of business, and the area of London is so great that this cannot be done by tramways alone. It needs a combination of relatively high speed railways, radiating from the centre, with tramway feeders, connecting the railways, laterally, with the districts through which they pass. An important point, which would be met by lines along the proposed Avenues, is that such railways should pass right through the central area of London—not merely enter it. This is required to enable the majority of passengers to be conveyed close to their destinations and, by distributing the traffic, to avoid the congestion, which now takes place, morning and evening at certain railway and tramway termini. These should not be tolerated in any crowded area such as the city of London.

Assuming the construction of railways along the routes of the Main Avenues, it is worth while to ascertain exactly what area they would serve (see Fig. 1). As already stated the morning and evening traffic, to and from the centre, is the governing factor. If that is satisfactorily dealt with, intermediate traffic is certain to be sufficiently provided for. Laying it down that, for effective service, the time occupied in travelling from door to door, must not exceed 45 minutes, and assuming that the stations on the railways along the Main Avenues are not more than about a mile apart, and are each fed by lateral tramways; that the average speed on the railways is 24 miles per hour, including stops, and on the feeder tramways 8 miles per hour; that the time occupied in walking, to and from the railways and tramways, is not more than 15 minutes, one half being taken at either end of the journey; the area properly covered may easily be calculated. As the central point of the north and south Main Avenue is at the crossing of Fleet Street, and that of the west and east Avenue at Liverpool Street station, the outer limits of this area would be 12½ miles from these points, measured along the Avenues, representing 30 minutes' railway travelling and 15 minutes' walking or together 45 minutes, the limiting time adopted.

Applying the same principle to intermediate points, it will be seen that, as the centre is approached, the area served widens out. For instance 6 miles from Liverpool Street or Fleet Street, only 15 minutes would be required in the train, and 15 minutes for walking, leaving 15 minutes available for a tram journey, equivalent to a distance of 2 miles, so that, at this point, the width efficiently served would be 4 miles, plus say half-a-mile, on each side, for walking distance. On the basis outlined, the total area served would be 162 square miles, of which 50 square miles would be included within a radius of 4 miles from

St. Paul's cathedral, and the remainder in four wedge-shaped pieces, extending to the four cardinal points of the compass (see Fig. 1). The present population within these areas is three millions, within the four mile radius, and 2,200,000 within the wedge-shaped pieces. Thus, railways along the Main Avenues would serve a total present population of 5,200,000.

Within the central area the major portion of the population would only use the railways incidentally, that is, not for the purpose of travelling to and from their business, but that of the outer districts would chiefly use them, in the morning and evening, to travel to and from work. The importance of the latter traffic far outweighs that of the former and, in estimating the need for the suggested railways, their convenience to the residents within the four mile radius may be neglected, except when dealing with their earning capacity. The probable growth of population has already been touched upon. The outer wedge-shaped areas include those districts which are growing most rapidly and where there is enormous scope for increase. It is therefore not unreasonable to suppose, that if the total population of London in 1931 be over 9 millions, that of these areas will be at least four millions, which figure is little more than the arithmetical proportion due to the present number of inhabitants.

Taking the number of journeys per head, per annum, made by Londoners, at 250 (in New York it exceeds 300) a population of four millions would make 1,000,000,000 journeys per annum and, although this total includes every kind of journey, whether in omnibus, tramcar, or train, it will at least serve to indicate the very large requirements with which railways along the proposed Main Avenues would be in touch, and it will enable some idea to be formed as to how far the following estimates are reasonable. In calculating the actual traffic likely to be carried by the railways and tramways, it has been assumed that it would take 15 years, from the date of commencement of construction, to acquire the necessary land, sell the surplus, and build the works. Before construction could be commenced the details of the scheme must be thoroughly worked out and parliamentary sanction obtained. The following figures must, therefore, be considered as applicable to the year 1924 or thereabouts. Having regard to the particulars already given of the vast total needs of the areas served, and to the uniform success so far as regards traffic which has attended the construction of new and improved facilities for passenger transport in London, it may be safely affirmed that these railways and tramways are more likely to be worked to their utmost capacity than to suffer from a lack of patronage. Upon the Central London Railway nearly 7½ millions of passengers are carried per mile per annum,

and upon the Metropolitan and Paris Railway, which is a more extended system, over seven millions.

The traffic on the whole 48 miles of the Main Avenue railways is estimated at 251,000,000 passengers per annum, or 5,230,000 per mile of line per annum, equal to about 70 per cent. of the results secured by the Central London Railway. It is estimated that the tramways along the Main Avenues would carry 4,000,000 passengers per mile per annum, or a total for the 48 miles of 192,000,000, the figures being based upon the actual results of tramways in large towns, allowance being made for the intention to charge ½d. fares and for the short average distance likely to be travelled.

There are three types of railway which it would be practicable to build in connection with the Main Avenues, namely: (1) Suspended, over the motor road (see Figs. 2, 3 and 4); (2) Shallow subway, beneath the lower roads where the Main Avenues are double decked (see Fig. 5); (3) Tube. The suspended railway is a new type of overhead structure, an example of which, 8½ miles long, has been in operation between Vohwinkel and Barmen, in Germany, for the past three years. This line traverses important and very narrow streets, but has proved entirely satisfactory, and now carries upwards of 10,000,000 of passengers per annum. It differs materially from all other types of railway, the carriages being hung from a single rail, without guide wheels of any description. The supporting girders are extremely light; there is no decking, and the motive power is electricity. Both as regards aesthetic appearance, obstruction to light and air, and silence in working, the suspended railway would be infinitely superior to an overhead line of the type used in New York or at Liverpool, the construction of which, in a situation like that under consideration, would be quite out of the question. Neither shallow subway, nor tube railways, need any detailed description. Constructed in connection with the Main Avenues, the former would sometimes be below the level of Thames high water mark, which might give rise to difficulties, and sections of the latter would require to be built through water-bearing strata, and might be very costly. Any method of tramway construction could be adopted, but the overhead conductor is suggested on the ground that it is by far the cheaper and is also more efficient, while the width of the proposed roads minimises the objections to posts and wires.

The following Table gives the estimated cost of the two Main Avenues, exclusive of the railways and tramways along them. The land and buildings were valued by Mr. W. Ralph Low, A.R.I.B.A., who also estimated the recoupment from the sale of

surplus lands. The figures for the north and south Main Avenue include the whole cost and recoupment of the property at the junction of the two Avenues, which accounts for the variation in the figures. The cost of the works at this point is divided equally between the Avenues.

MAIN AVENUE.	PROPERTY.		WORKS.	PROPERTY AND WORKS.
	Cost.	Recoupment.	Cost.	Net Cost.
	£	£	£	£
North to South ..	31,343,000	36,789,000	10,020,000	4,574,000
West to East ..	39,843,000	33,801,000	10,695,000	16,737,000
Totals £	71,186,000	70,590,000	20,715,000	21,311,000

The cost of the Railways and Tramways, including complete equipment, would be as follows:—

Case I.—Railways suspended .. .. .	£8,640,000
Case II.—Railways in shallow subway .. .. .	17,040,000
Case III.—Railways in tubes .. .. .	21,552,000

It is proposed that for tariff purposes these railways should be divided into zones, namely: a central zone comprising the lines within a radius of 4 miles from St. Paul's cathedral, or approximately the middle 8 miles of both the north and south and east and west railways; and an outer zone in sections formed by the extremities of each railway, each about 8 miles long. After 7.30 a.m. and before 11 a.m. there would be a uniform fare of 3*d.* per passenger entering the trains in the terminal zone, and 2*d.* between the same hours for those entering in the central zone. Before 4.30 p.m. and 8 p.m. the position would be reversed. During the rest of the day, the fares over the whole system would be 2*d.*, except that before 7.30 a.m. return tickets would be issued for one fare, that is 3*d.* in the outer zone, and 2*d.* in the central zone. On the basis of the greatest distance it would be possible to travel, the foregoing normal fares represent  $\frac{1}{12}$ th and  $\frac{1}{12}$ th of a penny per mile, respectively, and for workmen  $\frac{1}{15}$ th of a penny per mile; they are less than the fares at present charged by any railway company. On the tramways  $\frac{1}{4}$ *d.* fares would be taken, and the average per passenger is estimated at 0.8*d.* Upon the basis of these fares, and the before mentioned traffics, it is estimated

DIAGRAM  
OF  
PROPOSED MAIN AVENUES AND ROADS

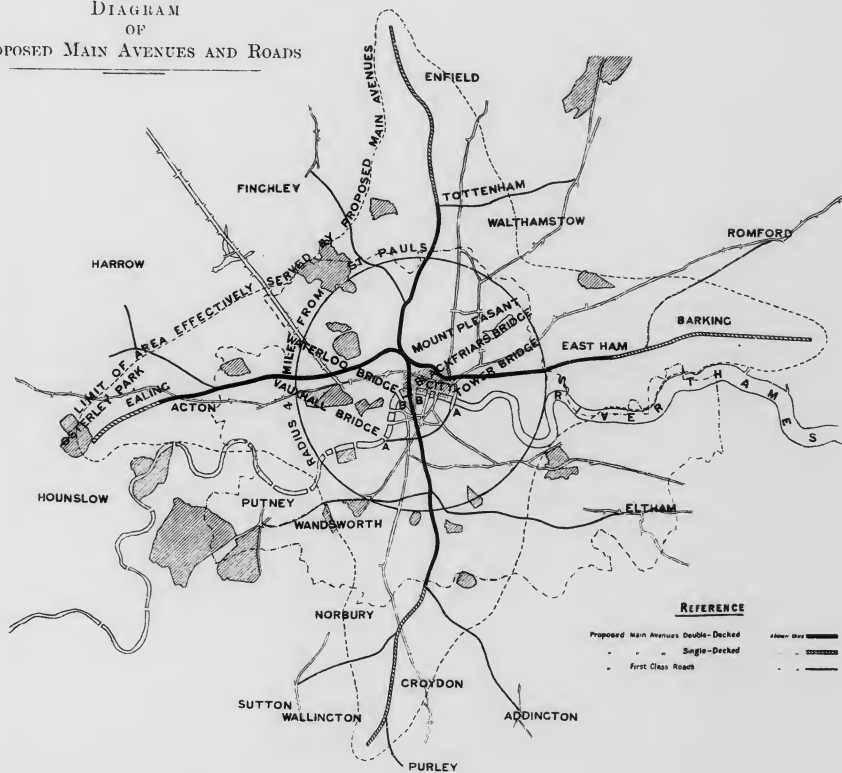


FIG. I.

*Published by Messrs. Meik & Beer, 10, Abchurch Lane, London.*

**REDUCTION  
RATIO  
14:1**

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# PM-MGP METRIC GENERAL PURPOSE TARGET PHOTOGRAPHIC

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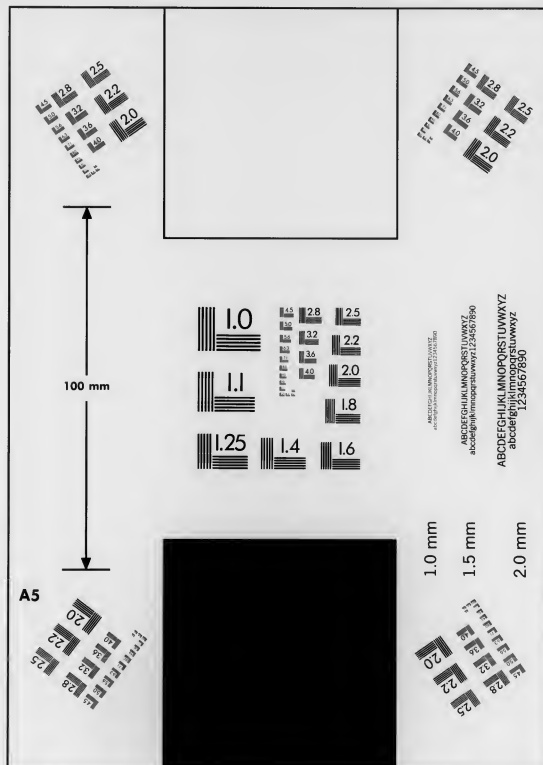
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100 mm

A5

A4

A3



## PRECISION<sup>SM</sup> RESOLUTION TARGETS



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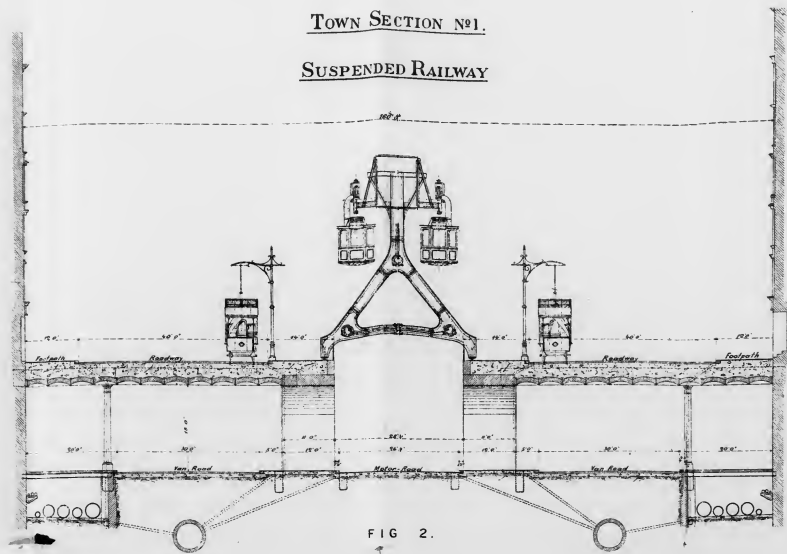
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PROPOSED MAIN AVENUES

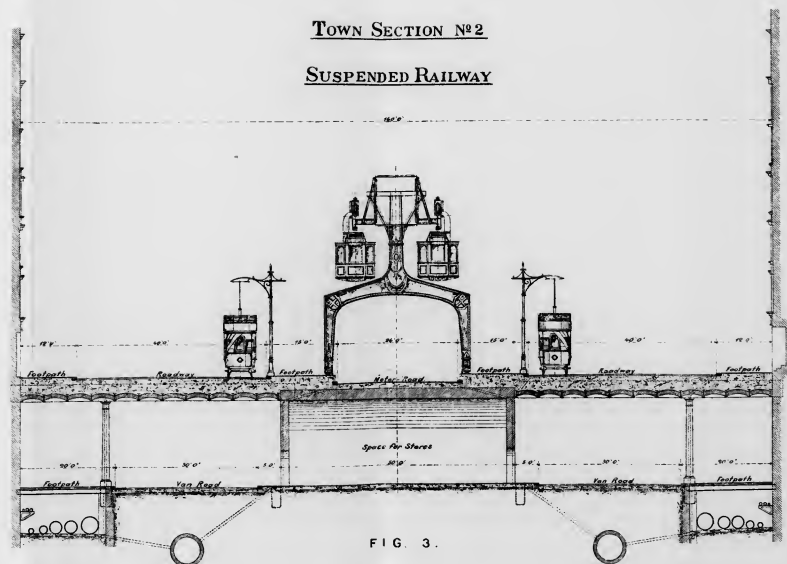
TOWN SECTION N<sup>o</sup>1.

SUSPENDED RAILWAY



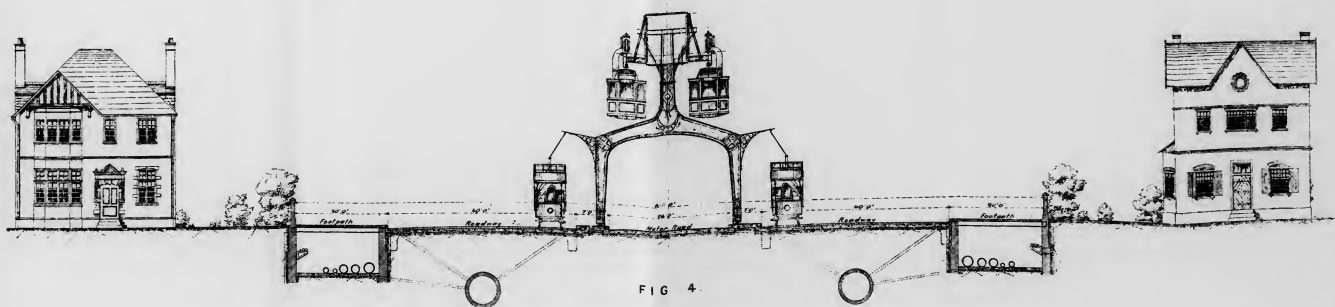
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SUSPENDED RAILWAY

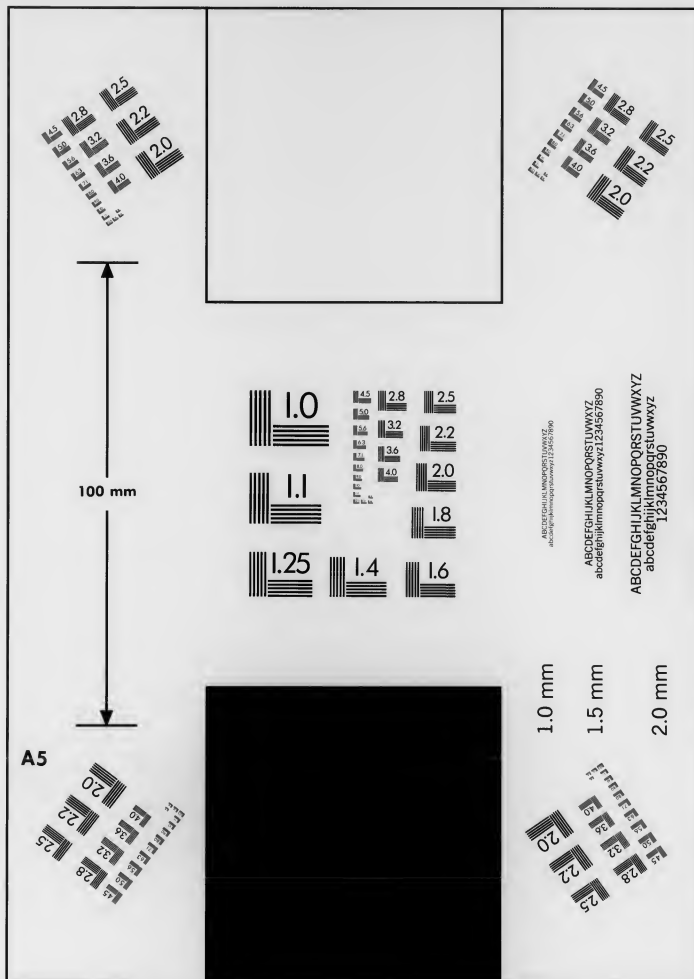


COUNTRY SECTION

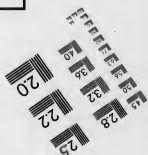
SUSPENDED RAILWAY



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11:1**



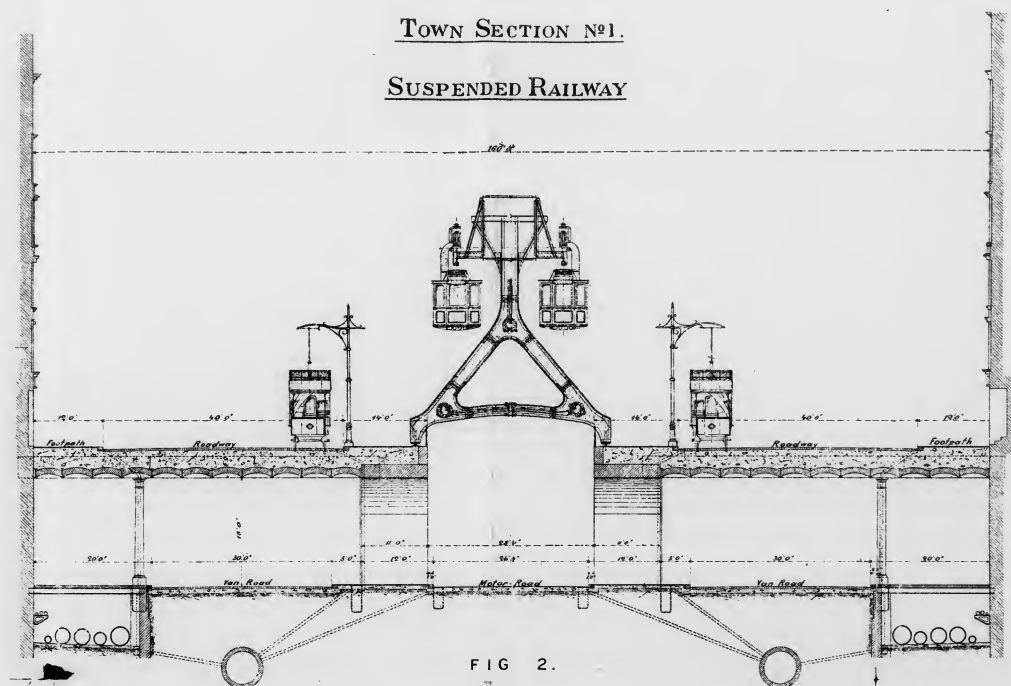
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# PROPOSED MAIN AVENUES

## TOWN SECTION Nº1.

### SUSPENDED RAILWAY



## TOWN SECTION Nº2

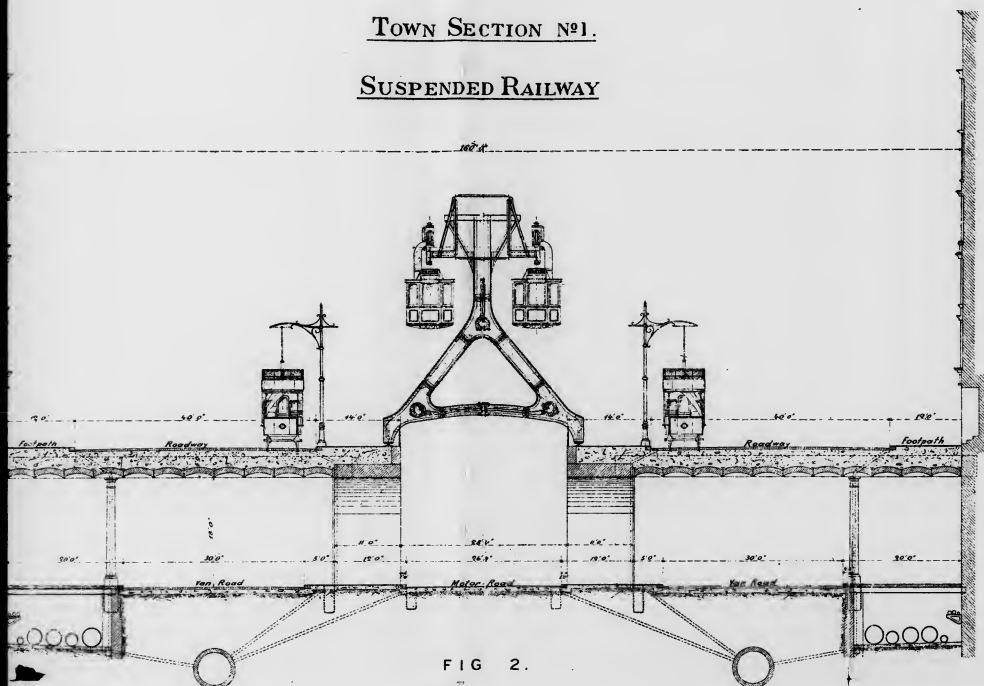
### SUSPENDED RAILWAY



## PROPOSED MAIN AVENUES

### TOWN SECTION N°1.

### SUSPENDED RAILWAY



### TOWN SECTION N°2

### SUSPENDED RAILWAY



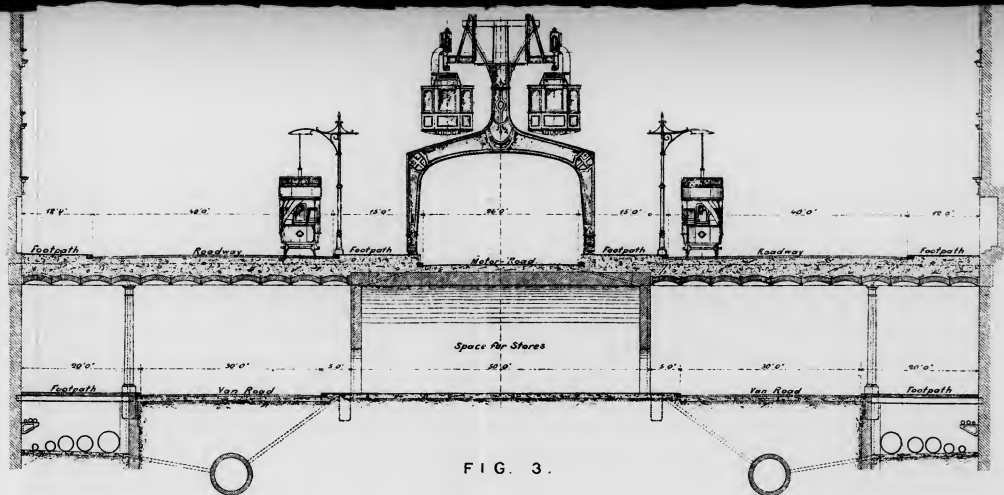


FIG. 3.

COUNTRY SECTION  
SUSPENDED RAILWAY

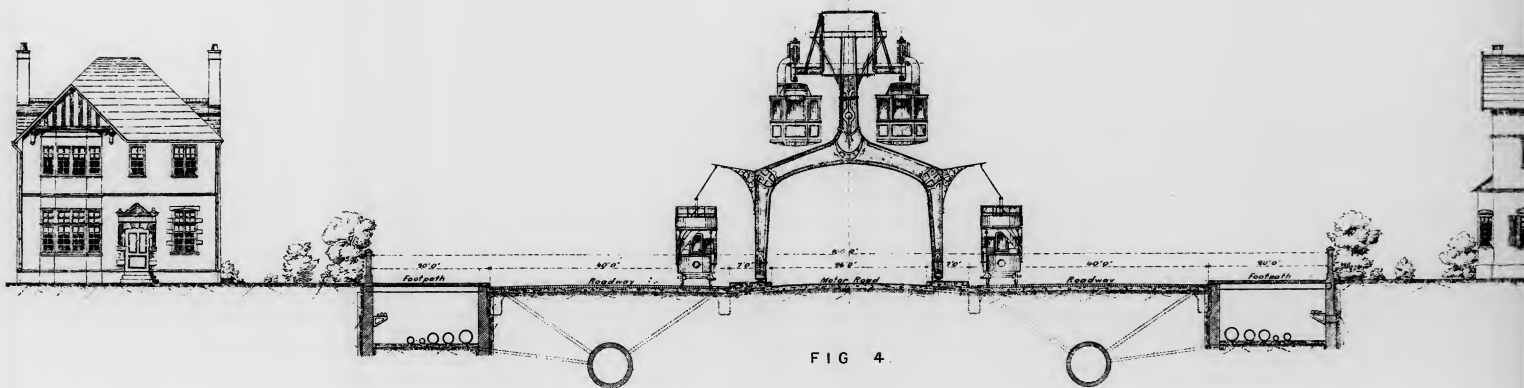
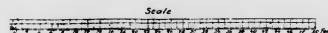


FIG. 4.



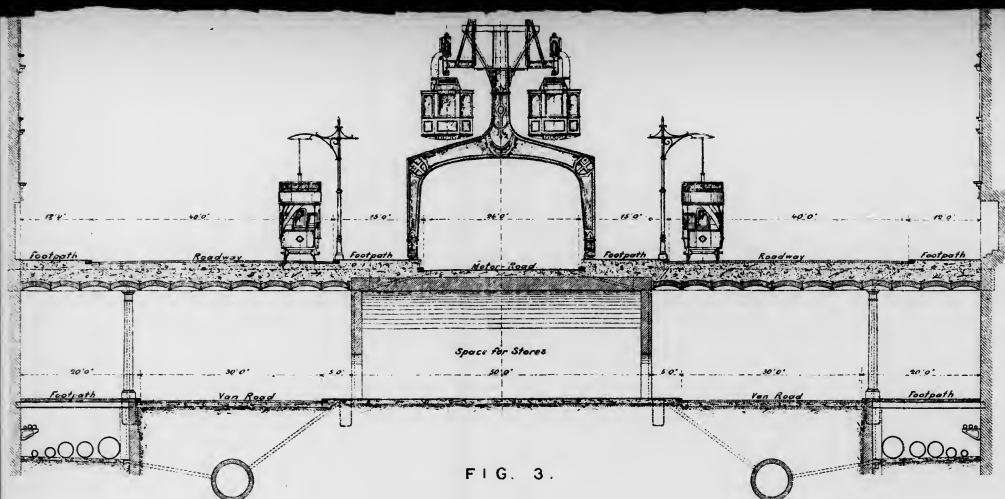


FIG. 3.

COUNTRY SECTION  
SUSPENDED RAILWAY

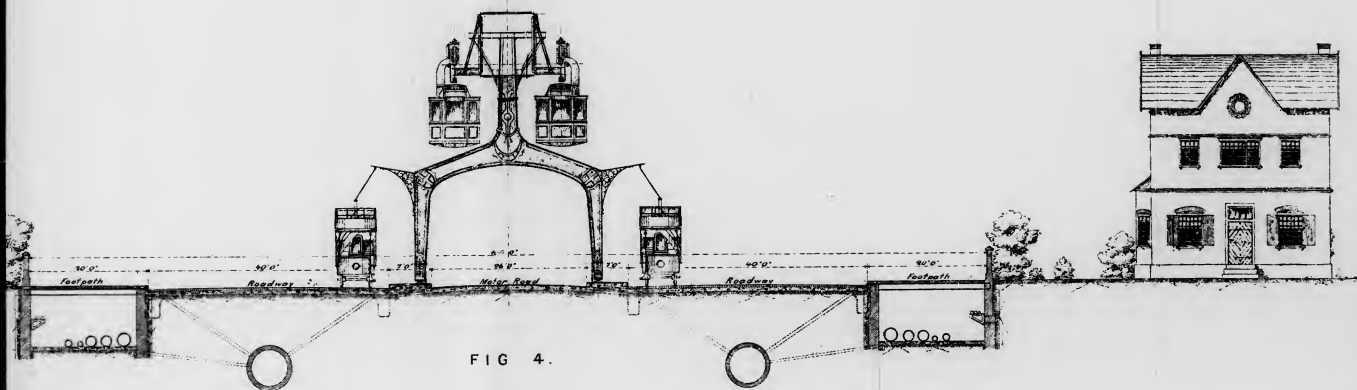
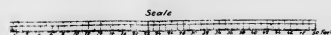


FIG. 4.



**REDUCTION  
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14:1**





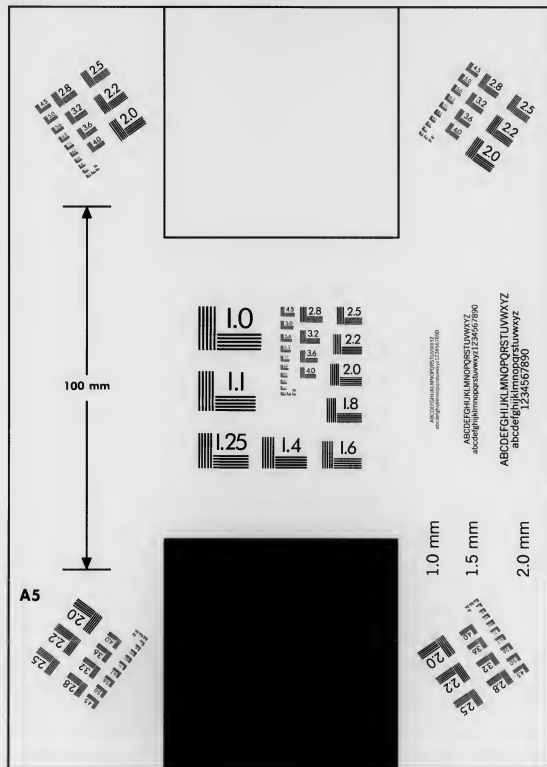
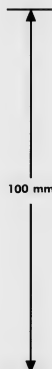
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# PM-MGP METRIC GENERAL PURPOSE TARGET PHOTOGRAPHIC



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## PRECISION<sup>SM</sup> RESOLUTION TARGETS



A&P International  
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612/736-9329 FAX 612/736-1496

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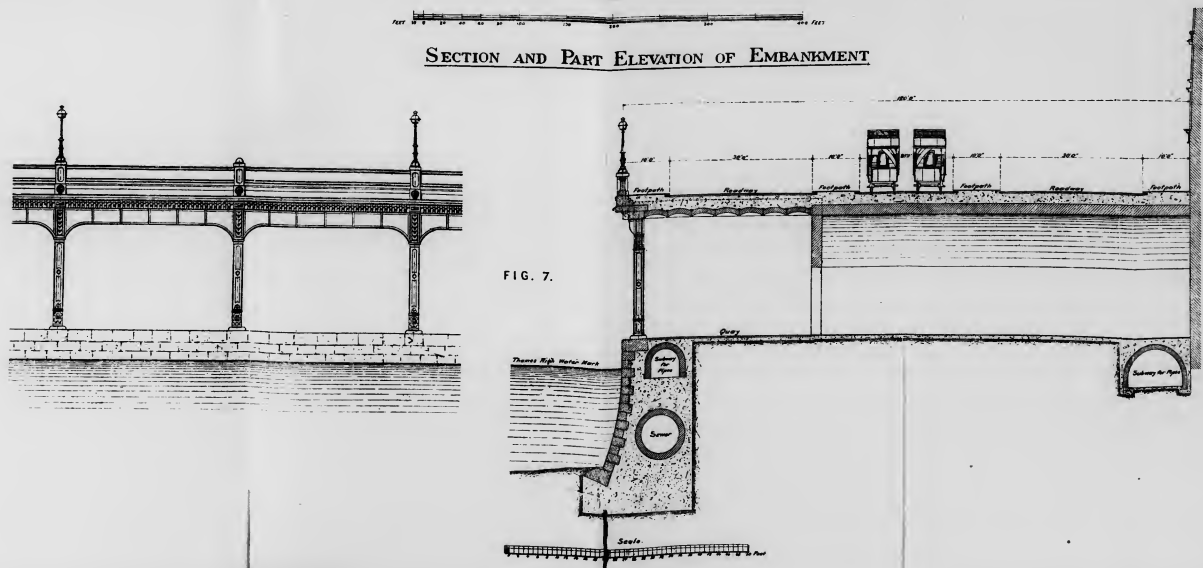
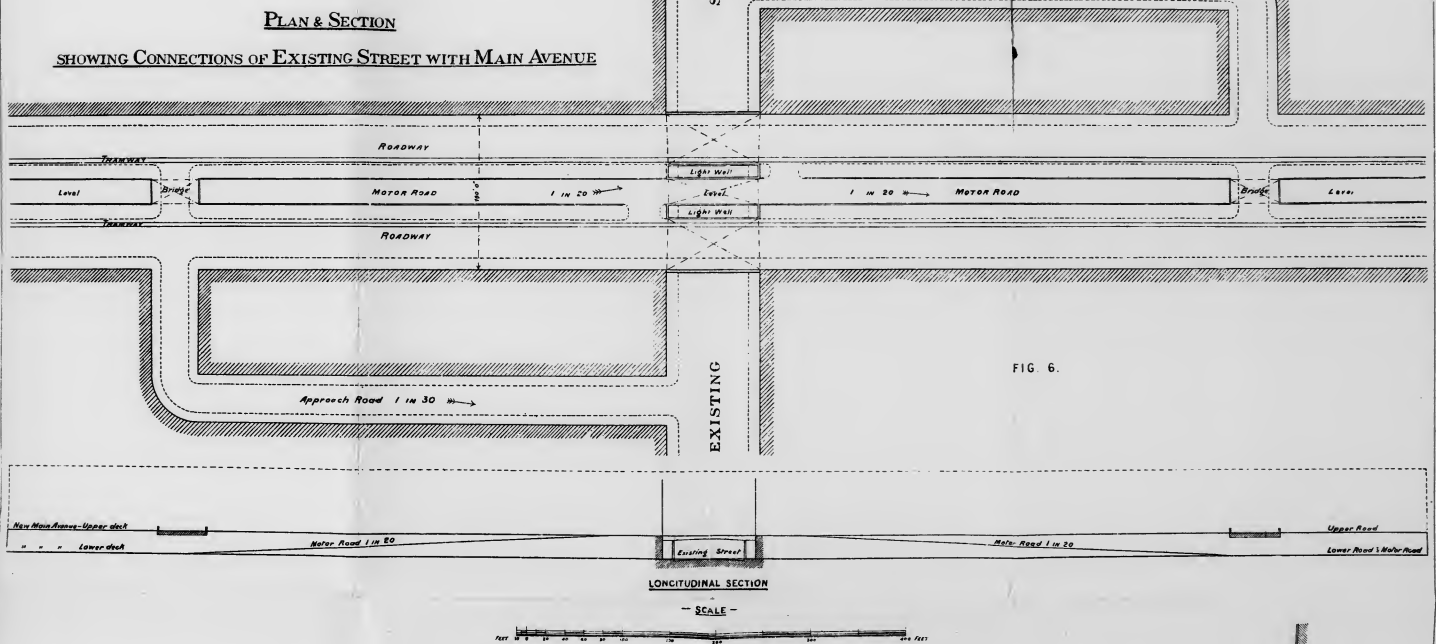
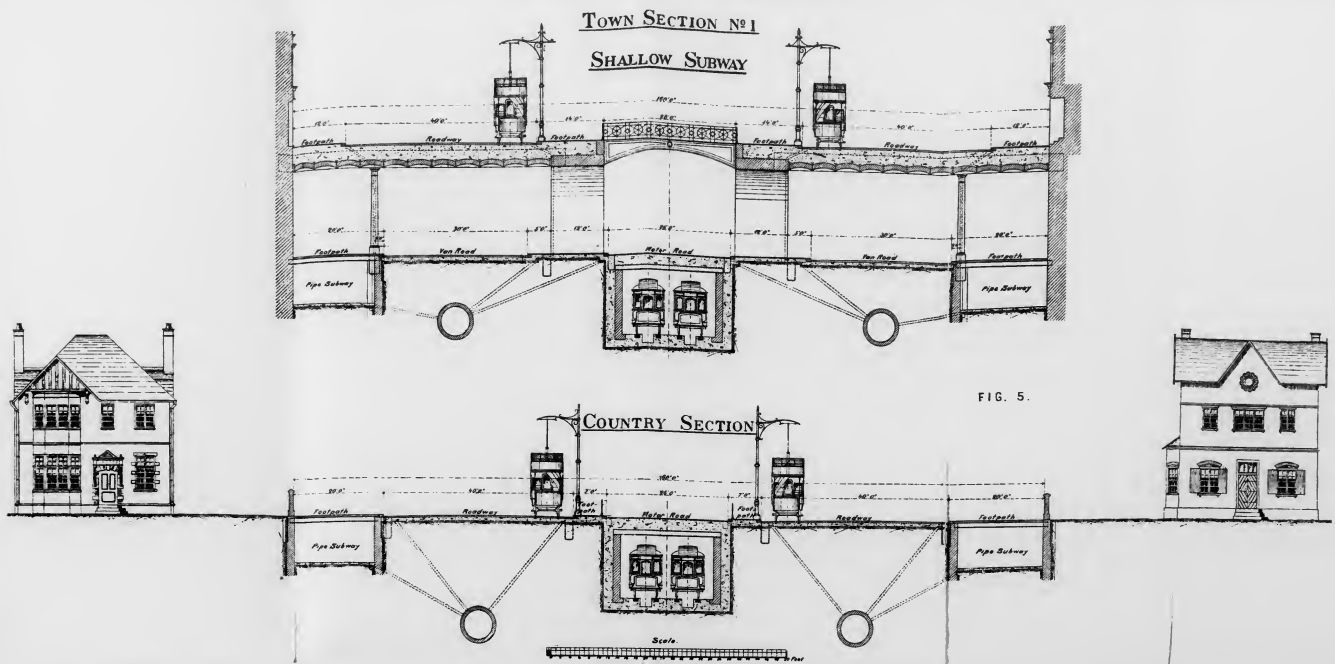
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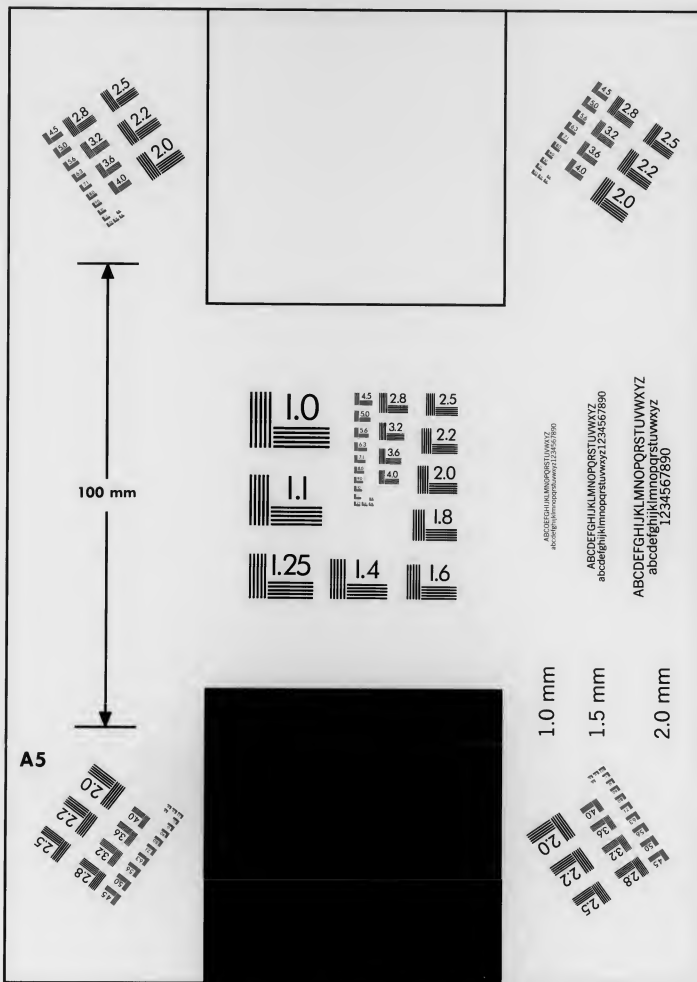
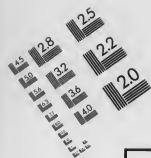


# PROPOSED MAIN AVENUES



**REDUCTION  
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11:1**

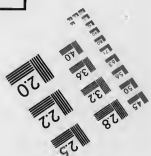
# PM-MGP METRIC GENERAL PURPOSE TARGET PHOTOGRAPHIC



PRECISION<sup>SM</sup> RESOLUTION TARGETS



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# PROPOSED MAIN AVENUES

## TOWN SECTION N°1

### SHALLOW SUBWAY

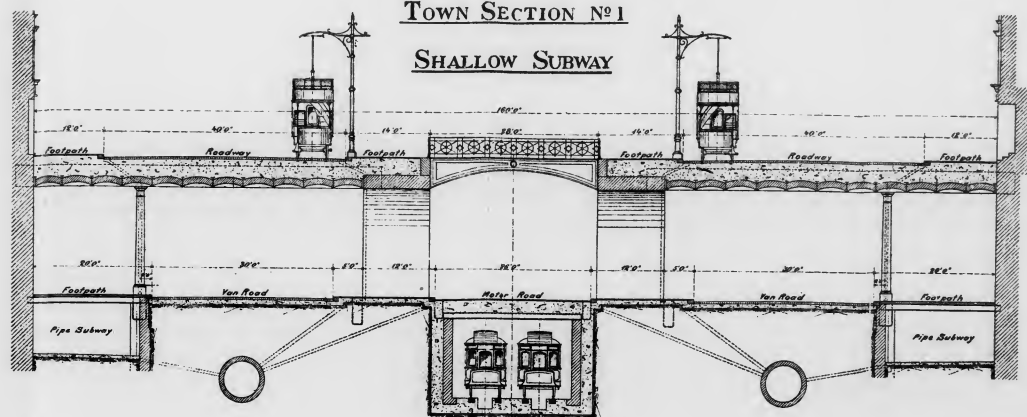
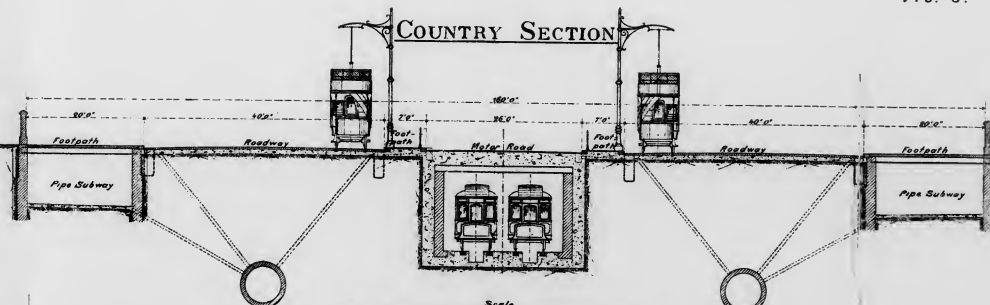


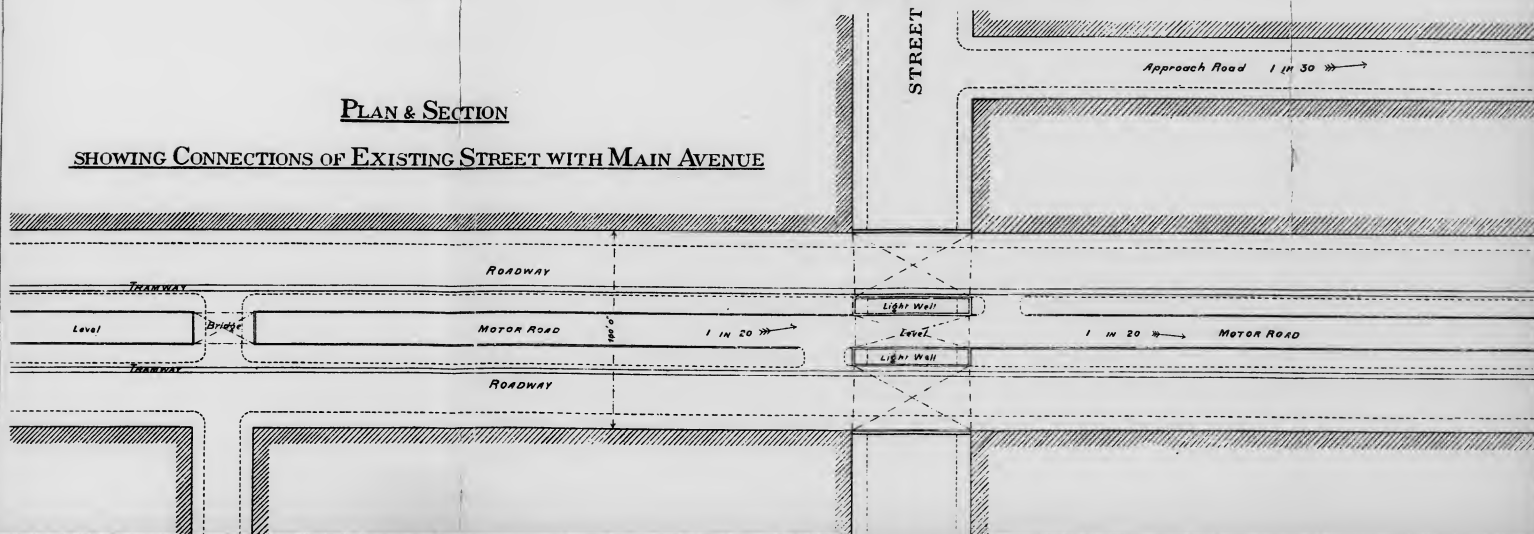
FIG. 5.

## COUNTRY SECTION



## PLAN & SECTION

### SHOWING CONNECTIONS OF EXISTING STREET WITH MAIN AVENUE



# PROPOSED MAIN AVENUES

## TOWN SECTION N°1

### SHALLOW SUBWAY

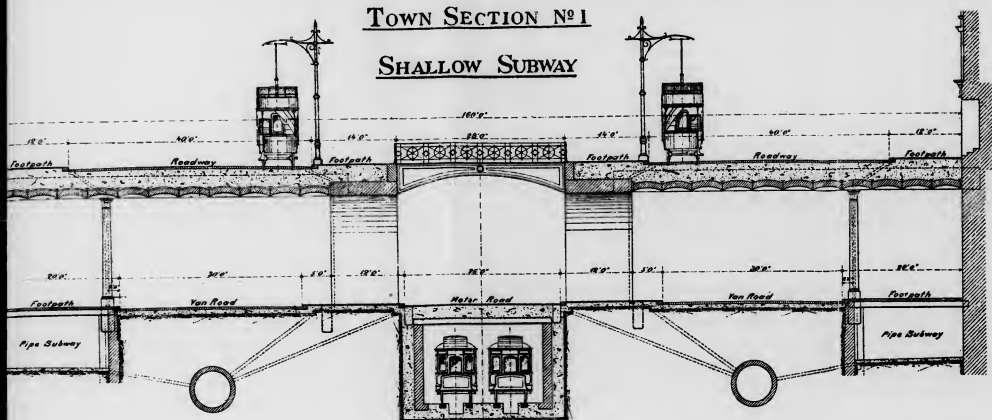
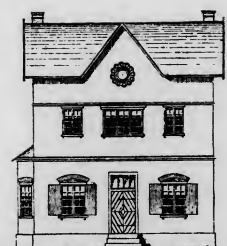
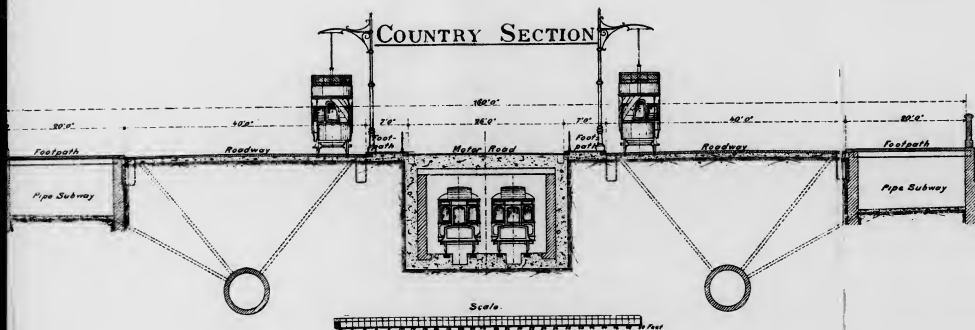


FIG. 5.

## COUNTRY SECTION



## STREET WITH MAIN AVENUE

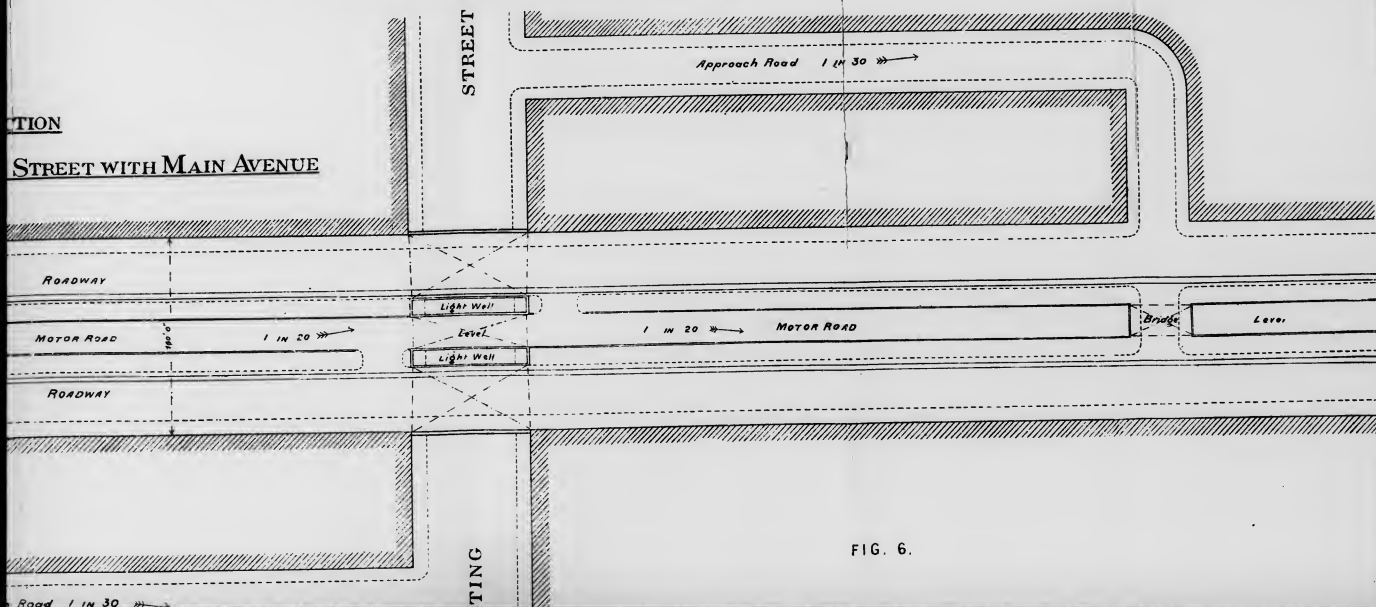
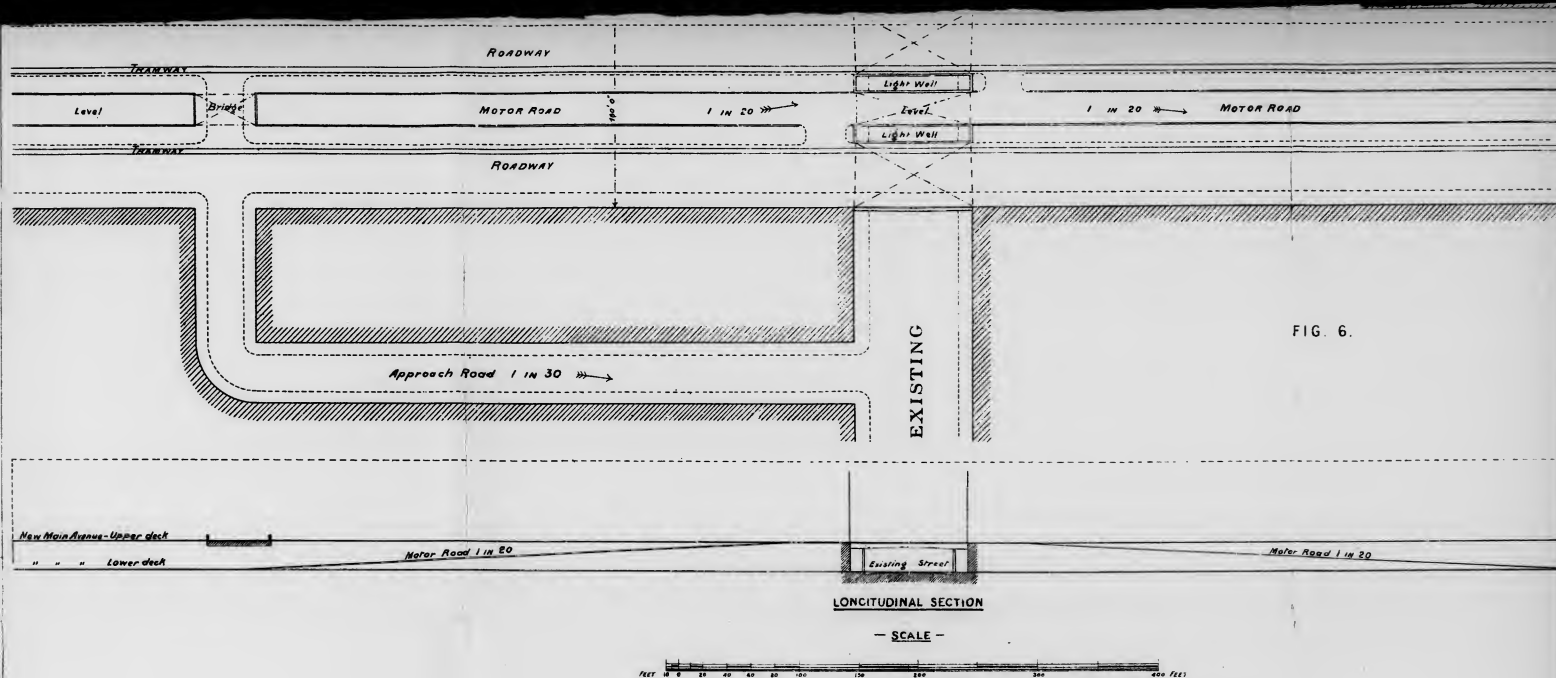


FIG. 6.



SECTION AND PART ELEVATION OF EMBANKMENT

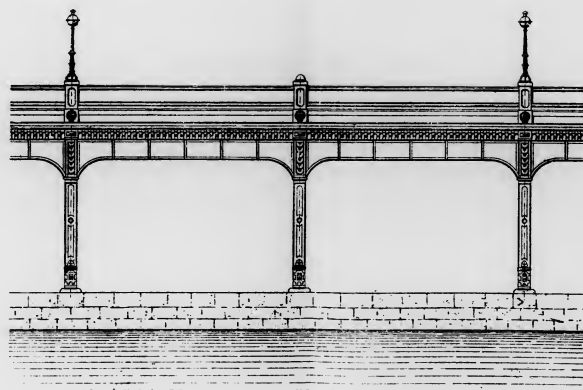
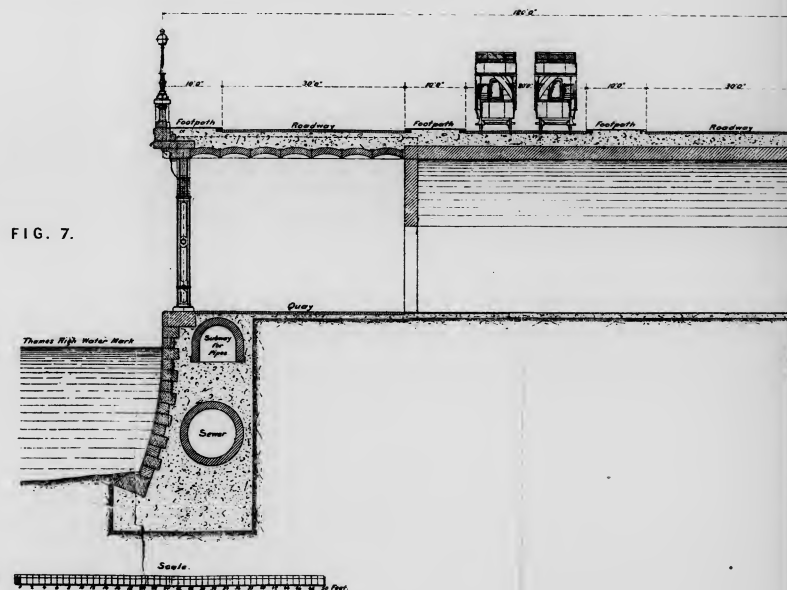
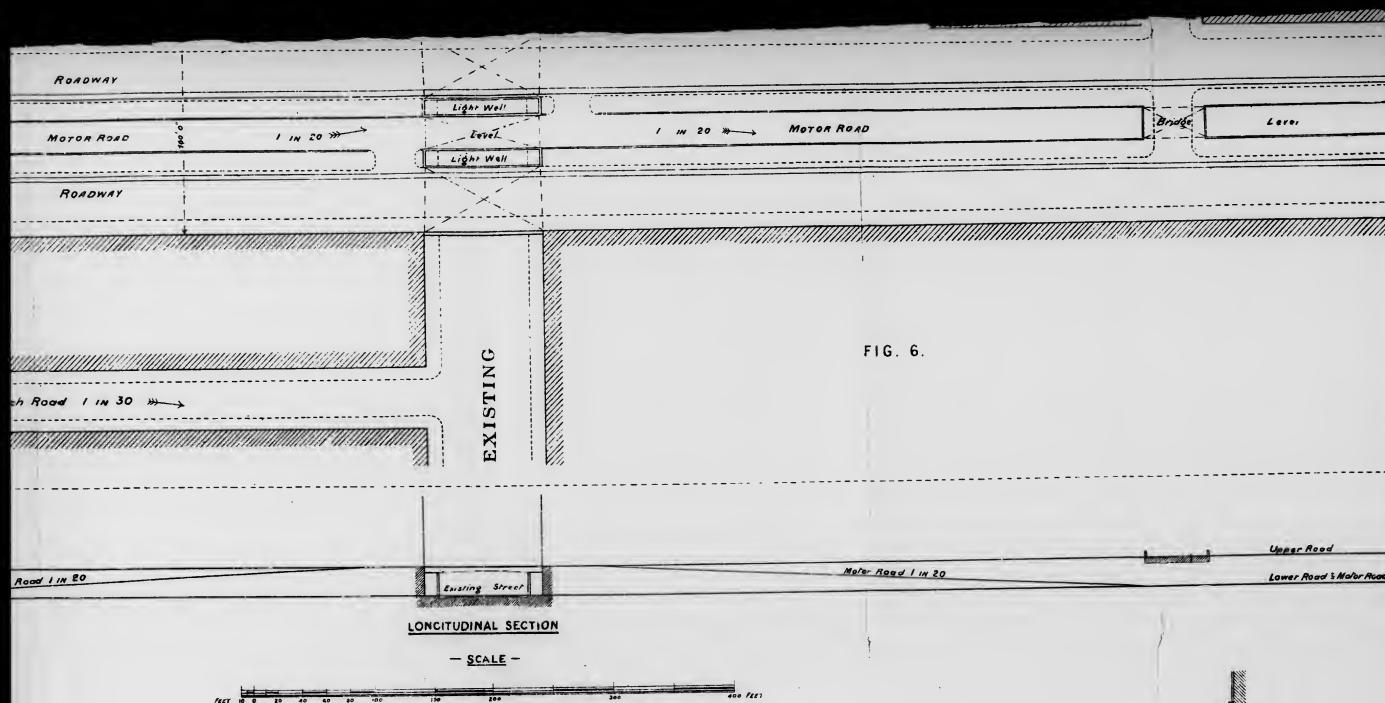


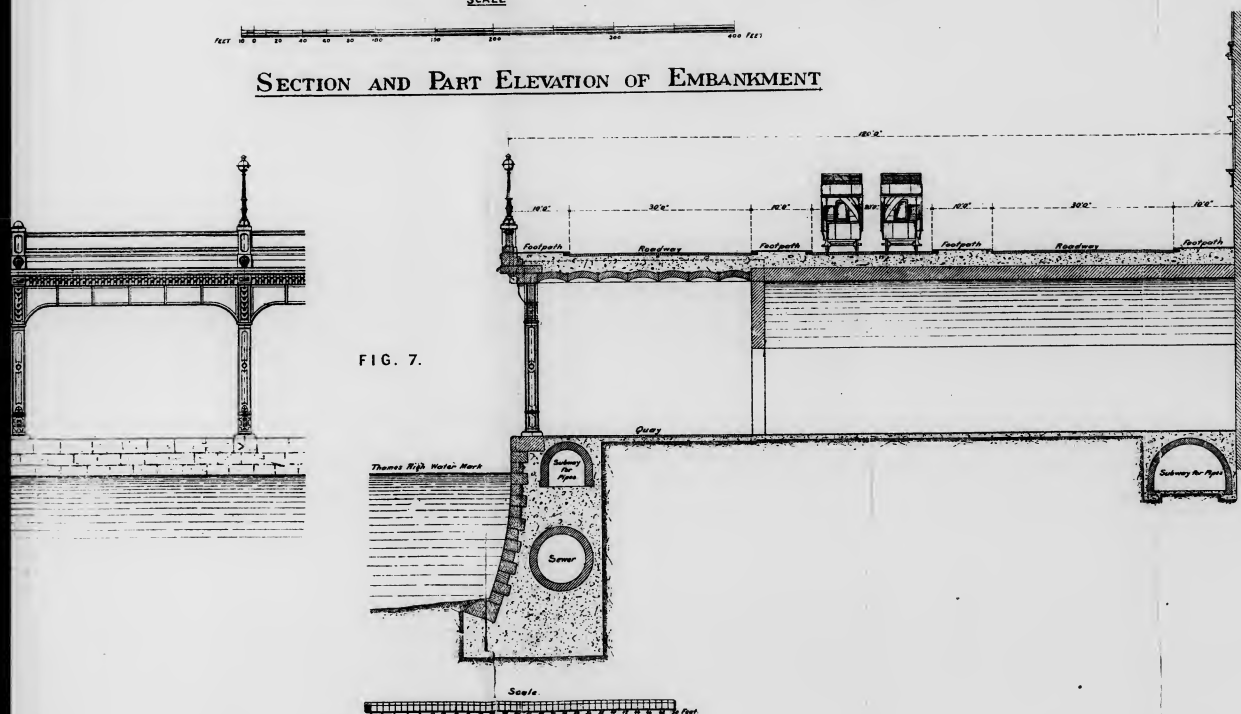
FIG. 7.







SECTION AND PART ELEVATION OF EMBANKMENT





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1.5 mm  
ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz1234567890



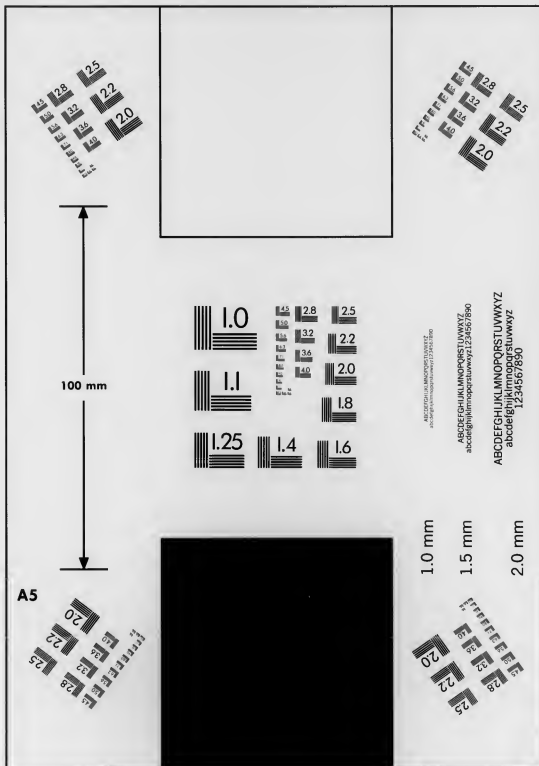
# PM-MGP METRIC GENERAL PURPOSE TARGET PHOTOGRAPHIC



200 mm

150 mm

100 mm



ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz  
1234567890

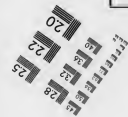
1.0 mm  
1.5 mm  
2.0 mm

2.5 mm

A3

A4

A5



## PRECISION<sup>SM</sup> RESOLUTION TARGETS



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ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz  
1234567890

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz1234567890

3.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz1234567890

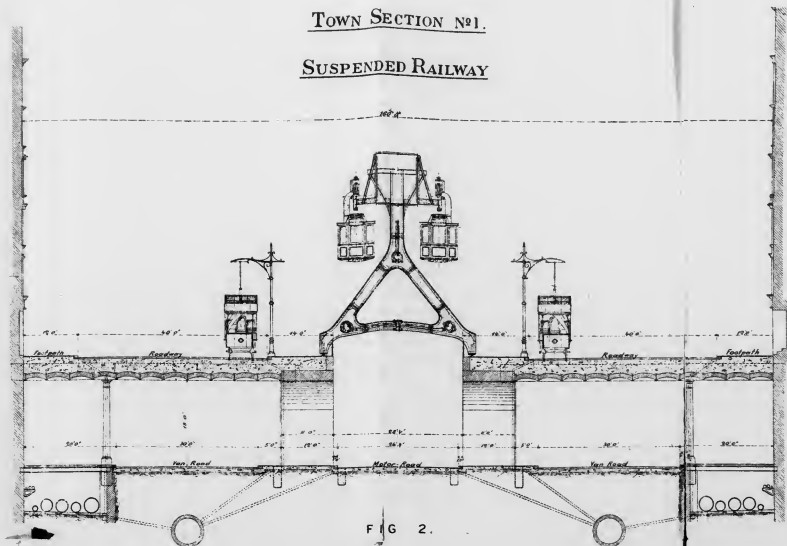
3.0 mm



# PROPOSED MAIN AVENUES

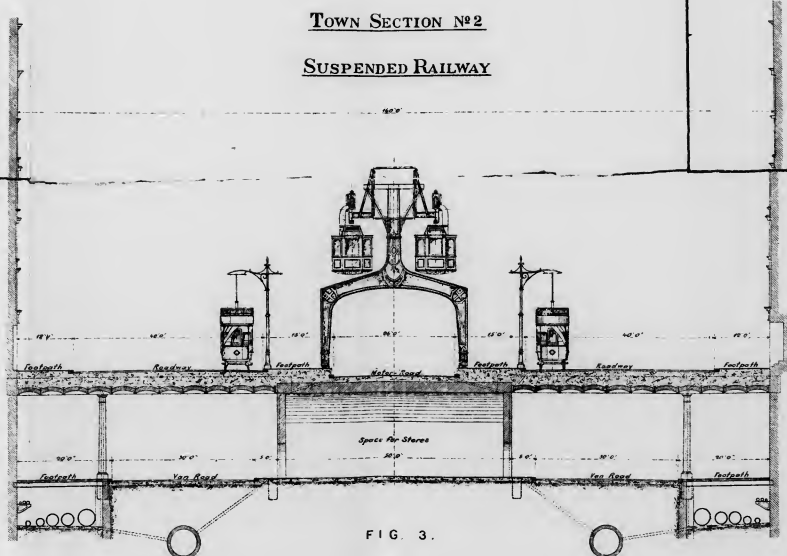
## TOWN SECTION N<sup>o</sup> 1.

### SUSPENDED RAILWAY



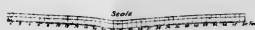
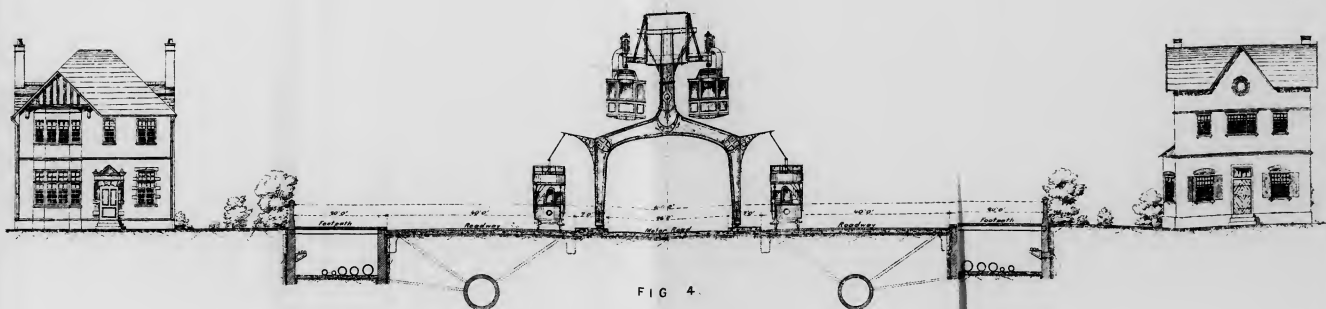
## TOWN SECTION N<sup>o</sup> 2.

### SUSPENDED RAILWAY



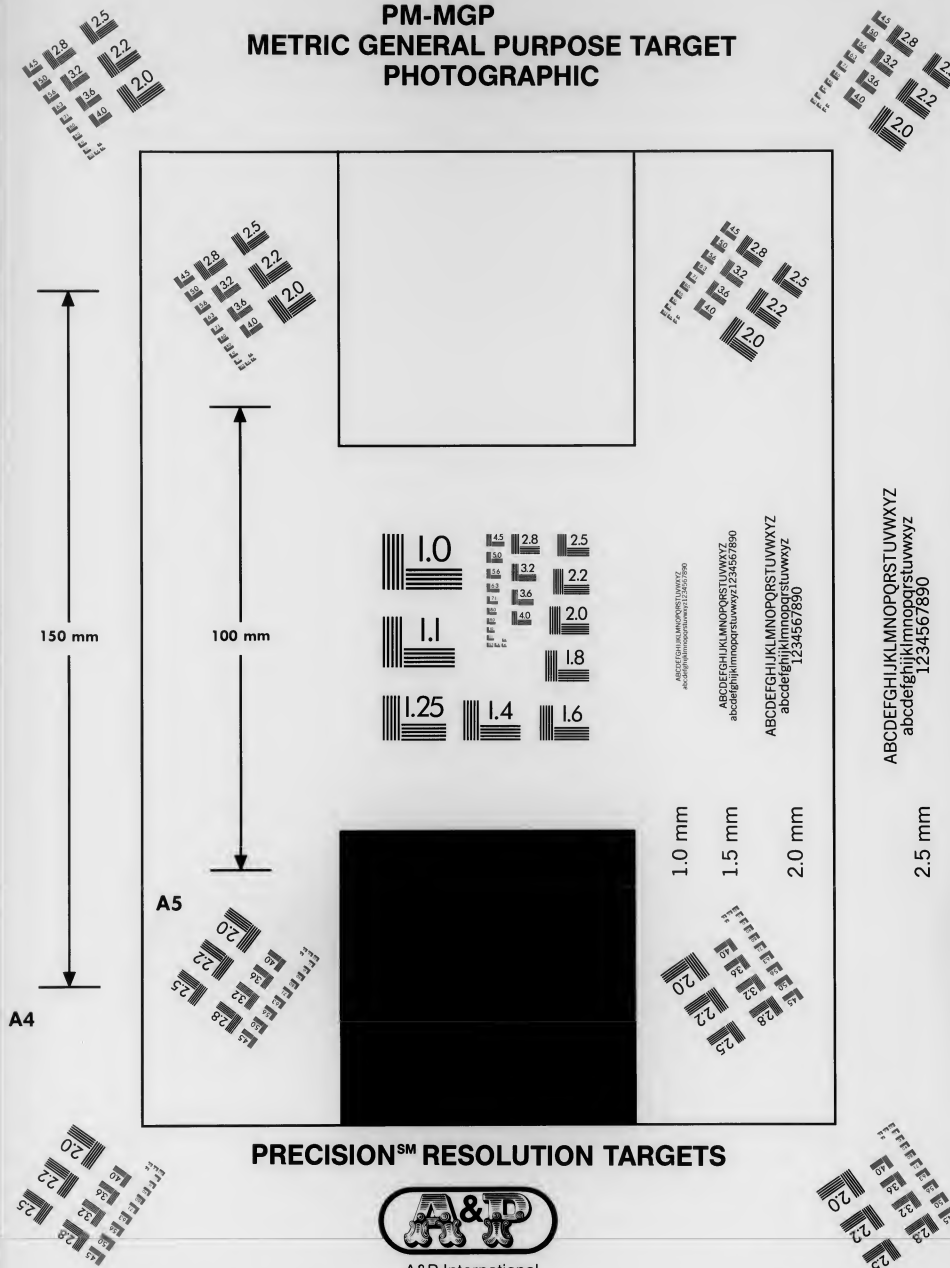
## COUNTRY SECTION

### SUSPENDED RAILWAY



**REDUCTION  
RATIO  
11:1**

# PM-MGP METRIC GENERAL PURPOSE TARGET PHOTOGRAPHIC



PRECISION<sup>SM</sup> RESOLUTION TARGETS

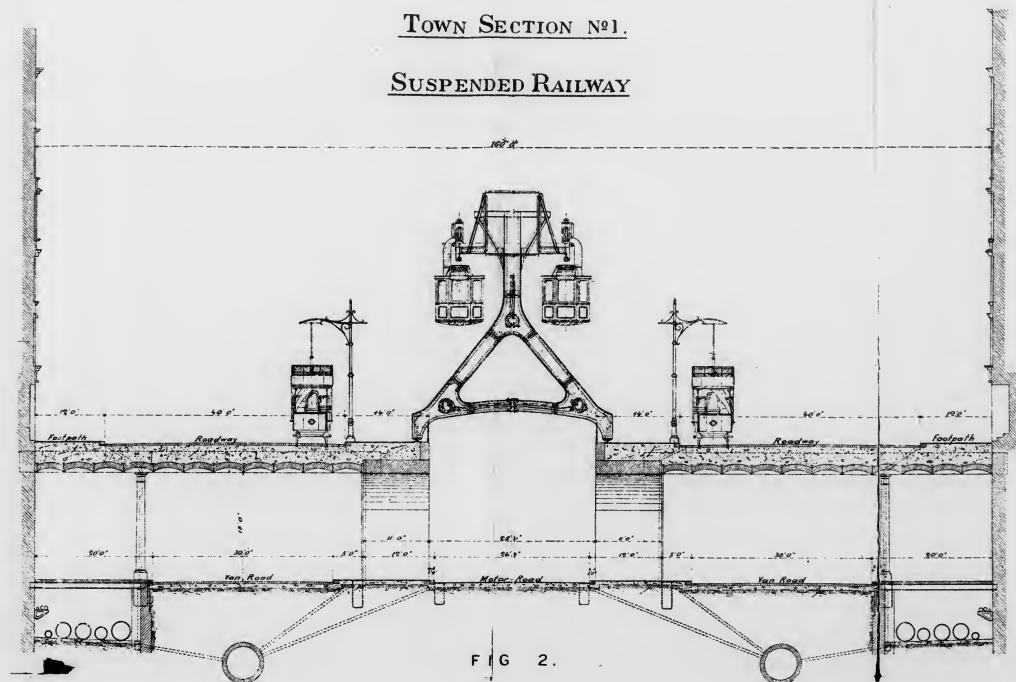


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## PROPOSED MAIN AVENUES

TOWN SECTION N<sup>o</sup> 1.

## SUSPENDED RAILWAY



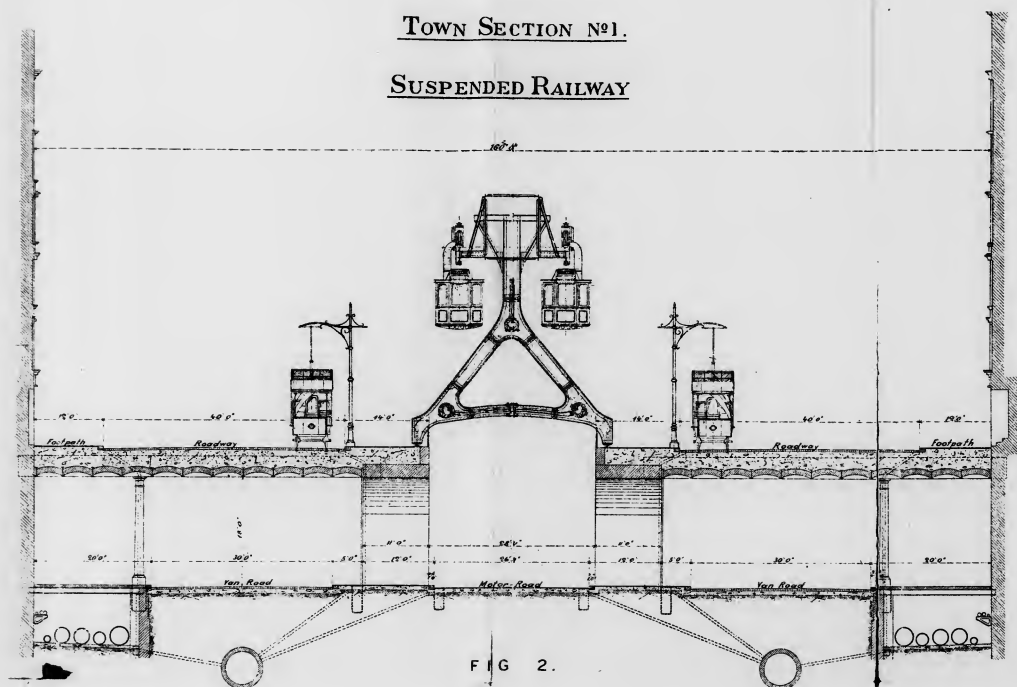
TOWN SECTION N<sup>o</sup> 2

## SUSPENDED RAILWAY

PROPOSED MAIN AVENUES

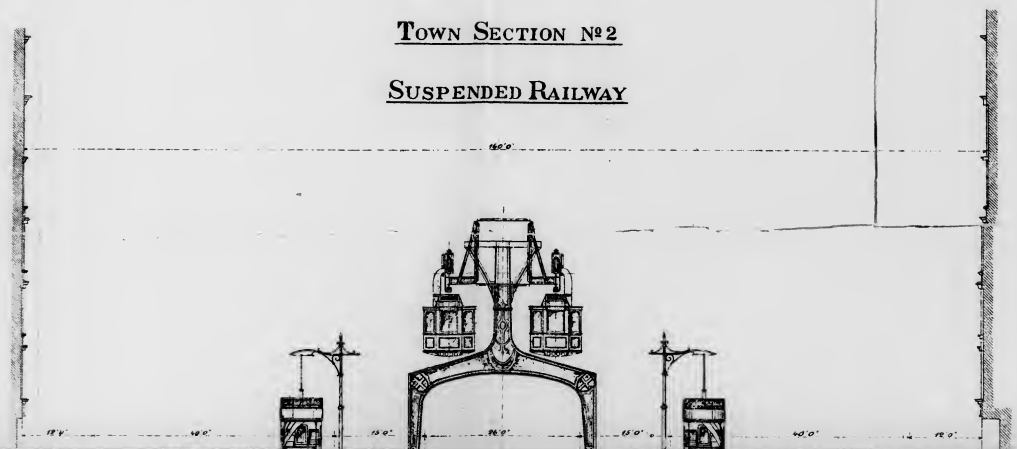
TOWN SECTION N<sup>o</sup> 1.

SUSPENDED RAILWAY



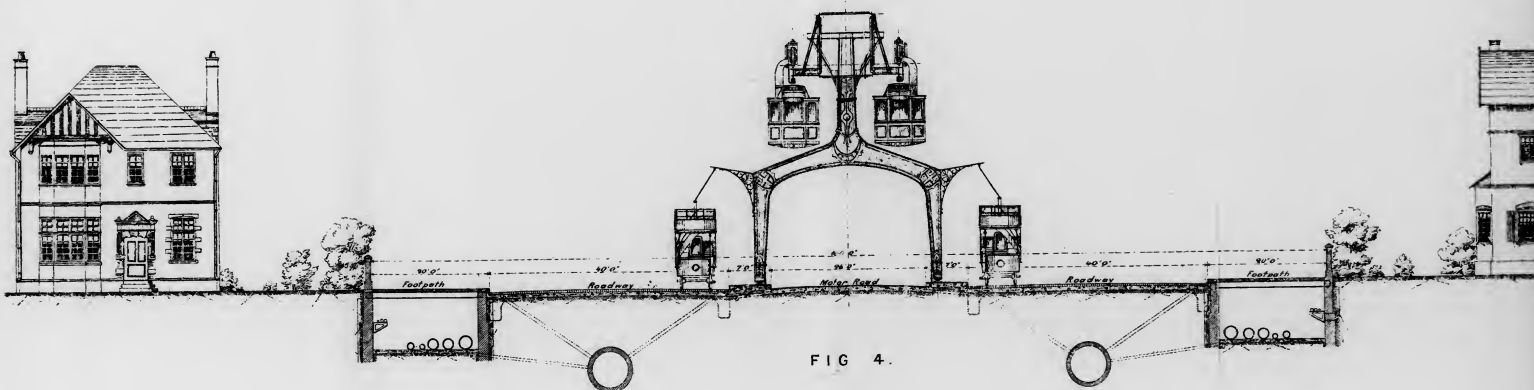
TOWN SECTION N<sup>o</sup> 2

SUSPENDED RAILWAY



Architectural cross-section of a bus shelter. The diagram shows a central structure with a roof supported by two pillars. The roof is labeled "Roof" and the central structure is labeled "Bus Shelter". The shelter is flanked by two pillars, each with a "Light" fixture. The ground level is labeled "Ground". The shelter is situated on a "Roadway" with "Footpath" on either side. Dimensions are provided for various parts: the total width of the shelter is 40' 0"; the width of the central structure is 16' 0"; the width of the pillars is 4' 0" each; the height of the pillars is 12' 0"; the height of the roof is 10' 0"; the height of the light fixtures is 10' 0"; the height of the ground level is 10' 0"; the height of the road surface is 10' 0"; the height of the footpath is 10' 0"; the height of the road surface is 10' 0"; the height of the footpath is 10' 0".

COUNTRY SECTION  
SUSPENDED RAILWAY





SUSPENDED RAILWAY

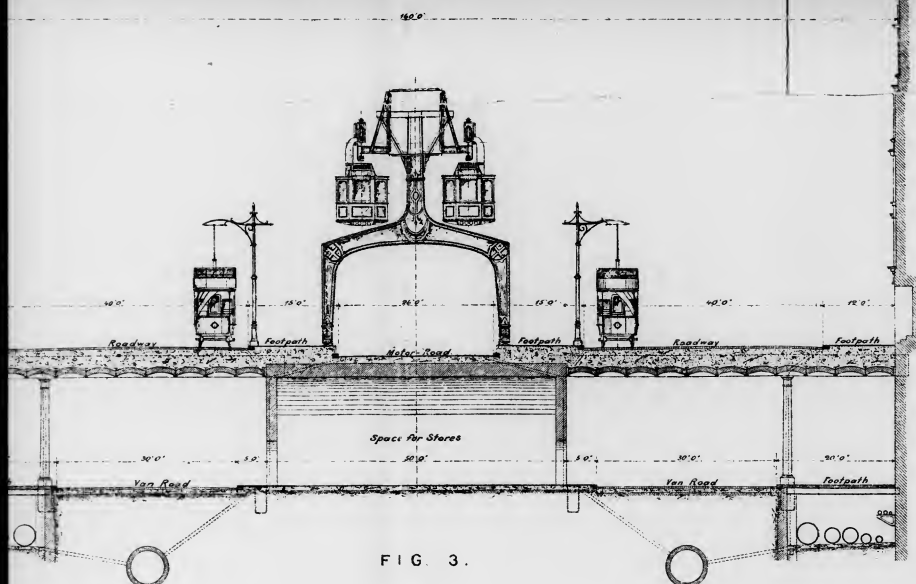


FIG. 3.

COUNTRY SECTION  
SUSPENDED RAILWAY

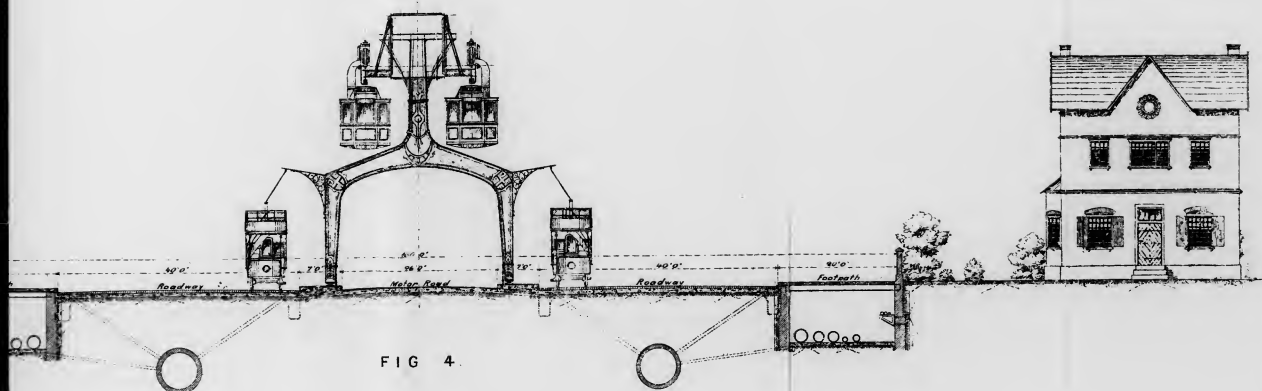


FIG. 4.



that the gross revenue from both railways and tramways, during the sixteenth year from the commencement of construction, when the whole scheme would be complete and the out-lying districts traversed largely developed, would be 3,377,500*l.* and the net revenue 1,624,750*l.* The preceding estimates of cost do not include interest on capital during construction, which must be taken into account to enable an opinion to be formed of the financial aspect of these proposals. Including this item, the position during the sixteenth and following years would be:—

*Case I.—Main Avenues with suspended railways:—*

Total capital expenditure .. .. .	£33,137,000
Annual surplus, after providing interest at $3\frac{1}{2}\%$ and for the service of a sinking fund on a 60 years' basis .. ..	366,544

*Case II.—Main Avenues with railways in shallow subways:—*

Total capital expenditure .. .. .	£44,637,000
Annual deficit after providing interest and for the service of a sinking fund as before .. .. .	71,456

*Case III.—Main Avenues with railways in tubes:—*

Total capital expenditure .. .. .	£51,207,000
Annual deficit, after providing interest and for the service of a sinking fund as before .. .. .	321,116

In conclusion and summing up generally, it appears, (1) That new main thoroughfares are necessary to provide for the present and future needs of vehicular traffic. (2) That they must be combined with railways and tramways, in order to meet the requirements of the growing population for further and better means of passenger transport, and to render it economically possible to re-house the working classes disturbed. (3) That such new thoroughfares should commence and terminate in the more distant suburbs, traverse the central business area, and serve the great railway termini and other existing centres of traffic. (4) That they should be elevated in busy districts to pass over cross streets, the space below being occupied by auxiliary roads, and (5) That a portion of their width should be specially reserved for fast motor vehicles.

The specific proposals and estimates now put forward may fairly be said to show that the construction of new main roads on these lines is financially feasible, and might even be directly profitable, while great public benefit would result, not only from the improvement in means of communication, but also from the removal of insanitary and overcrowded dwellings.



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